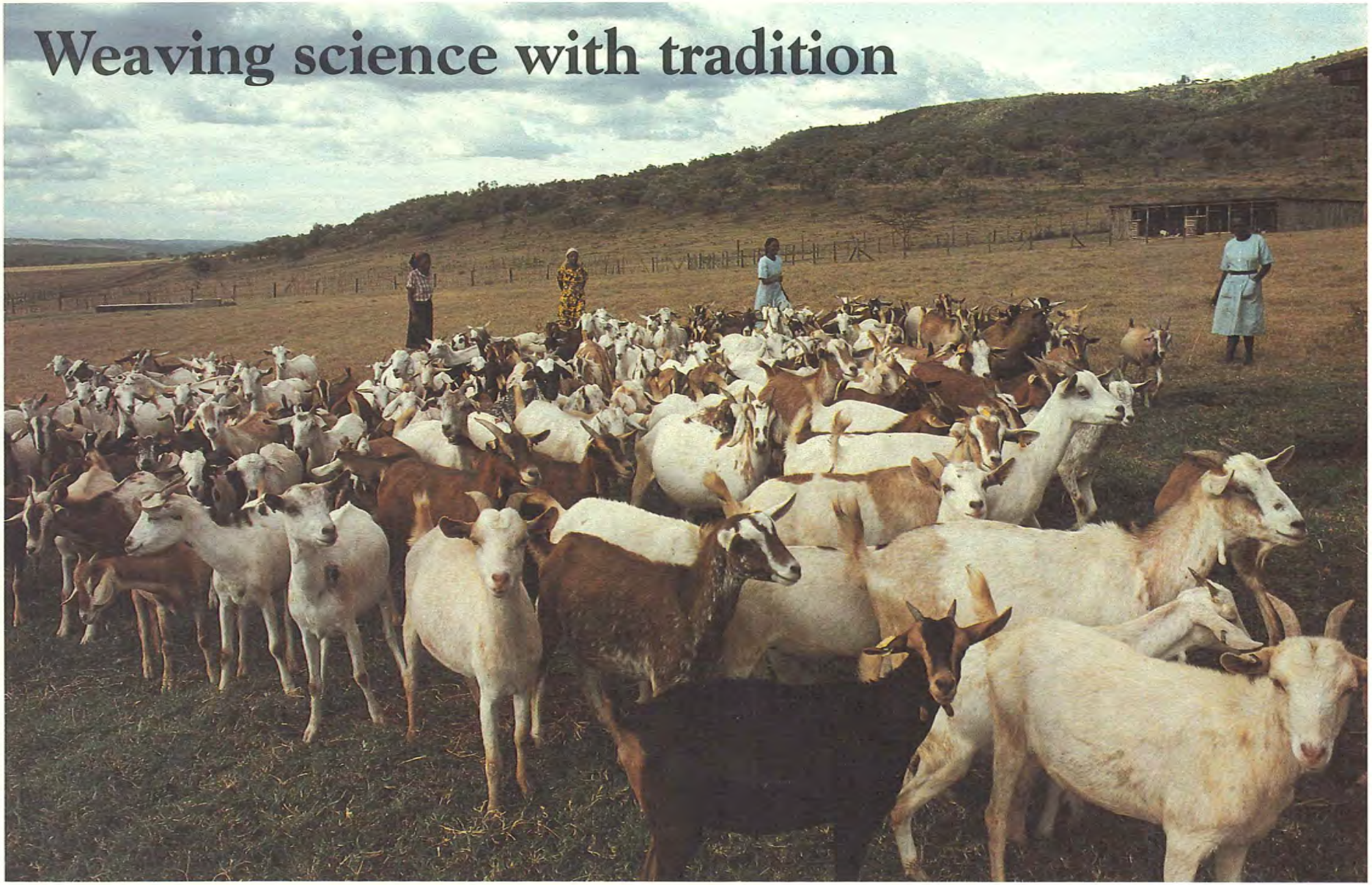
KENYA

Weaving science with tradition



A Report of the Small Ruminant Collaborative Research Support Program

The Small Ruminant Collaborative Research Support Program (SR-CRSP) in Kenya is a cooperative undertaking of the Kenya Agricultural Research Institute, the United States Agency for International Development and four United States institutions – Texas A & M University, the University of Missouri, Washington State University and Winrock International Institute for Agricultural Development. The University of California, Davis, serves as the Management Entity for the worldwide SR-CRSP effort.

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On the cover: Local women are the shepherds at Ol'Magogo breeding station. The women take what they learn at the station back to their home farms.

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Feeding more people from smaller farms

Since Kenya's best agricultural land is needed for export earnings, any increases in food supplies must come from the country's shambas *– family farms of just a few hectares.*

The Kenya SR-CRSP is producing efficient, high-yielding goats and an entire goat management system to help shamba owners feed their families and produce extra food for the country.

Most developing countries must meet two goals to become active in world commerce: They must provide a stable food supply for their citizens and they must build export markets to supply capital for country development.

In Kenya, these two goals, food and export income, are at odds.

Except for tourism, the lion's share of Kenya's national income comes from sales of coffee, tea and horticultural products. Agriculture nets 60% of Kenya's export earnings and 30% of the gross national product.

If Kenya is to increase food production, it must do so without sacrificing exports.

Food production is needed. Kenya's population is expected to expand by 50% — to 35 million — by the year 2000.

Kenya geographic conditions

Kenya is about the same size as Texas and straddles the equator on the eastern coast of Africa. Climate and soil conditions range from rich volcanic uplands with plentiful rainfall to flat plains that are hot, dry and sandy.

Less than 25% of the land has moderate to high potential for food production. Most of the country is arid or semi-arid, inhabited by pastoralists that cultivate few crops.

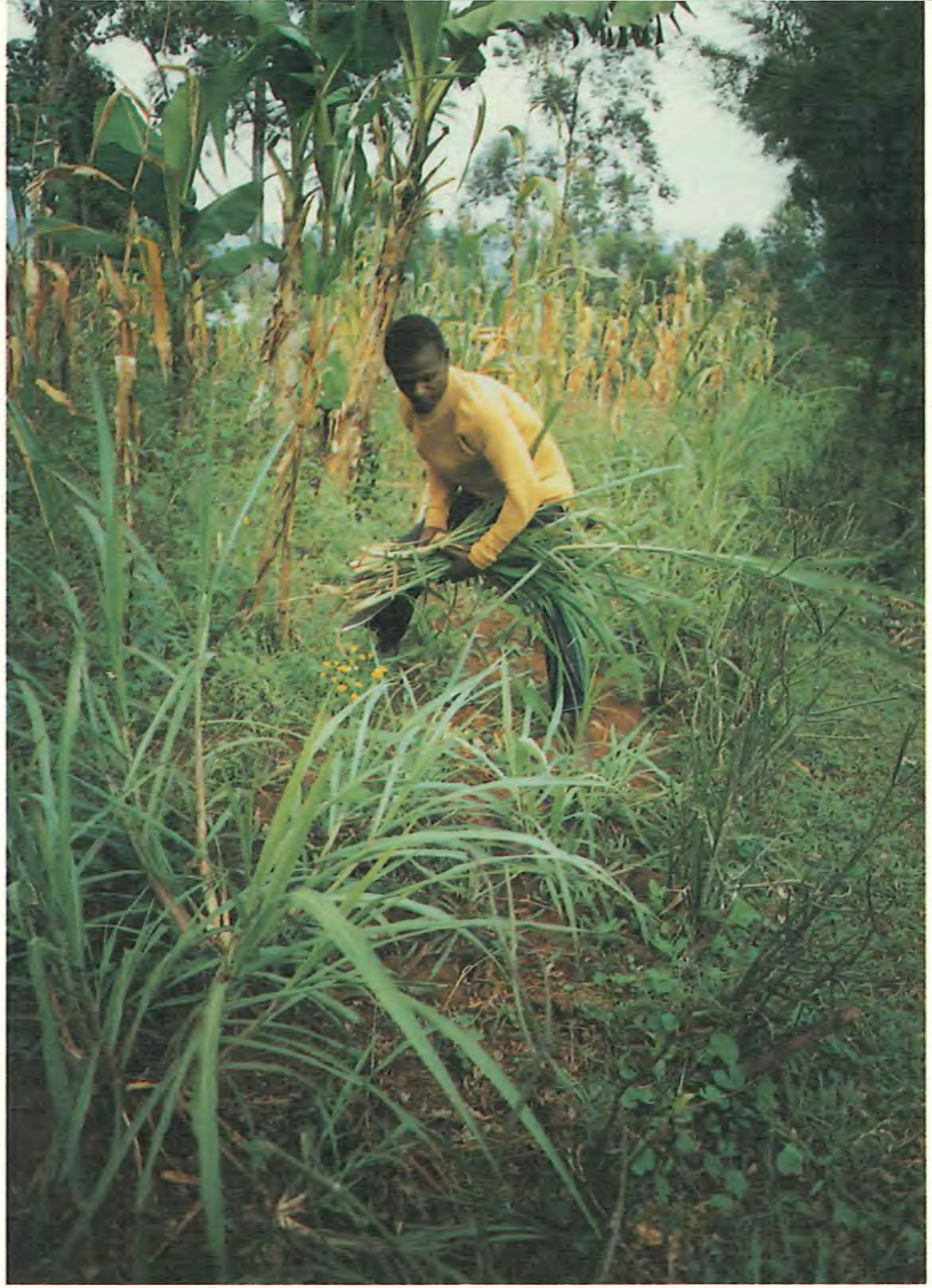
Much of the high potential land is where the

Nathan Livoi and his family, above, epitomize farming in western Kenya. He and wife, Agnes, fifth from left, have less than 1/3 hectare (3/4 acre) from which to feed their young family. The SR-CRSP dual-purpose goat (DPG) program was designed for families like theirs.

Livoi's current goats are crossbreeds, forerunners to the true DPGs. Yet the animals have already made a change in the family diet.

When one of Livoi's children was sick, extra milk from the goats supplied the protein he needed to recover.

This is why SR-CRSP breeding efforts are developing a goat with both high milk production and high meat yield.



Research at the Maseno model farm recommends growing a mix of grass and legume forages for goats in addition to feeding them leftover maize stover and leaves. Nathan Livoi collects napier grass from his version of the model farm.

country's coffee and tea production takes place. To save these export earnings, increases in food supplies must come from bringing more arid and semi-arid lands into production, and by increasing production efficiency on the moderate-potential lands that are already in food production.

It's not a simple process. Land ownership is a strong dream for most Kenyans. Farm size is shrinking drastically due to land sales and farmers dividing land among their children. Most of the 1.7 million small farms, or *shambas*, have less than 2 arable hectares (5 acres).

Western Kenya

The food situation is critical in densely populated western Kenya. Farms are small, most less than 2 hectares, and must support large families. The area receives up to 80 inches of rainfall annually, with many farmers able to grow two crops per year.

But this continuous cropping, combined with little available fertilizer, is quickly depleting the soil.

Farm husbands often leave their families to work in the tea and coffee plantations and railroad yards. Women must then care for both the farm and the family.

On-farm labor is also in short supply.

Historically, western Kenya has been a major labor source for the rest of the country. Farm husbands often leave their families to work in the tea and coffee plantations and railroad yards. In fact, many western families now get 60% or more of their income from off-farm sources.

Women must then care for both the farm and the family. So any strategies to increase food production in the region must require only small amounts of additional labor.

SR-CRSP program

The Small Ruminant Collaborative Research Support Program, or SR-CRSP, was started in 1978, three years after the United States Congress passed the International Development and Food Assistance Act. Title XII of that act — Famine Prevention and Freedom from Hunger — gave U.S. land-grant universities a mandate to help developing countries solve food and nutrition problems. Title XII projects were to "help the poorest of the poor."

The focus of SR-CRSP work is to improve the standard of living of people, not animals.

The SR-CRSP, known as "SR Crisp," became one of the most successful Title XII initiatives. This worldwide program focuses on small ruminants — animals such as sheep, goats and alpaca — to provide food and income for subsistence farmers.

Studies show 53% of the world's sheep and 94% of the world's goats are grown in developing countries. Most of these animals are owned by subsistence farmers or pastoralists. There are several reasons why small ruminants are so important in developing countries. These animals:

- Can grow on small acreage, with less forage needs than cattle;
- Can survive on marginal lands;
- Can supply meat plus milk or skins for home use or sale;
- Can supply needed manure to fertilize crops;
- Are easily cared for by all family members;
- Have low initial and maintenance costs versus larger animals.

Yet the production of small ruminants in developing countries can often be improved. Some areas need better feeding strategies or solutions to livestock pests and diseases. In others, SR-CRSP participants and host countries work to develop breeds that produce more meat, milk and/or wool under local conditions.

But in every case, the focus of SR-CRSP work is to improve the standard of living of people, not animals.

That's where the term "collaborative" comes in. SR-CRSP personnel aren't just veterinarians or animal geneticists. They make up a team of scientists who look at health, breeding, feeding and nutrition, economics, and social acceptance of the system that's developed.

Any technologies are examined to see if they can be sustained once the "experts" jobs are through. It's this holistic approach that sets the SR-CRSP apart from many other agricultural development programs.

The Kenya SR-CRSP has been one of the most truly collaborative efforts to date.

The Kenya SR-CRSP

The Kenya SR-CRSP began in 1981. Participants are the University of California, Davis, University of Missouri-Columbia, Washington State University, Texas A&M University and Winrock International, a private voluntary research organization. These five institutions banded together to help Kenyan researchers find ways to increase food production on the country's growing number of small farms. The team chose goats as the best small ruminant for the job.

Researchers agreed that western Kenya shambas needed a dual-purpose goat (DPG).

First, Kenyans have a tradition of animal ownership. Cattle have always been seen as a symbol of wealth. In many areas, meat and milk are the prime protein source for Kenyan families. Yet as farm size decreased, shambas became too small to grow enough feed for proper cattle nutrition.

Kenyans have raised goats for centuries. Yet lately, many small farmers felt

The holistic approach of the DPG system is based on producing a goat that can survive harsh conditions and thrive on native feedstuffs without reducing food needed for humans. The goats supply meat and milk for food or sale and offspring that can be used to build the herd or for sale to earn income.

they could not waste valuable food-producing land to grow forages for goats either.

The loss of meat and milk production hurt family nutrition. Damage to crop yields was even worse. Without manure from livestock, field fertility nosedived.

Early in the program, Kenyan and U.S. researchers agreed that western Kenya shambas needed a dual-purpose goat (DPG): one which could provide meat as local breeds did, but which would also supply enough extra milk for family nutrition. This DPG would need to survive the pest problems of Kenya and thrive on indigenous feeds.

The goat would also, they reasoned, not require large amounts of additional farm labor.

Since then, a team of several dozen Kenyan and U.S. researchers has worked to perfect the DPG idea.

The work is collaborative for institutions as well as scientists. In addition to the five U.S. institutions involved, research takes place within many Kenyan organizations and institutions. Research and sites include: animal health at the National Veterinary Research Centre, Kabete; breeding at the National Animal Husbandry Research Centre, Naivasha; and system testing and extension work at Maseno Research Station in western Kenya.

These sites are directed by the Kenya Agricultural Research Institute (KARI). KARI is a newly formed government organization designed to oversee all agricultural research in the country. Its mandate is to stimulate collaboration between research groups to increase food production and make efficient use of available resources.

KARI supplies facilities and personnel. Support funds come from the United States Agency for International Development (USAID) and are channeled into the SR-CRSP projects.

Animal breeding — improving the gene pool

SR-CRSP researchers determined that it will take a mix of four bloodlines to create the DPG, a goat with high disease resistance, faster weight gain and higher milk production.

These twin goat kids were the first composites born on cooperating farms. Composites are the offspring of two four-way crosses, animals that have some of each of the four basic breeds. Offspring of composites will be the true dual-purpose goat (DPG).

The heart of the Kenya SR-CRSP is the dual purpose goat, the DPG. In theory, this goat must survive local conditions and on local feeds, and must produce more meat and milk than indigenous breeds. Faster weight gains, better reproduction and improved milk production mean better nutrition and income from scarce land.

But it's critical that the DPG have high natural disease resistance. Most Kenyan smallholders lack funds for expensive drugs and veterinary care.

That's why two local breeds, the Galla and the Small East African, were chosen as the basis of the DPG. The Galla is a large, meaty animal with resistance to some diseases. The Small East African has survived for a millennia in the continent's harshest pastoral grazing areas. This long exposure makes it highly resistant to many pests, diseases and management hardships.

The local breeds lack harvestable milk production. To add that trait, SR-CRSP animal breeders and those at the National Animal Husbandry Research Centre, Naivasha, picked two proven producers: the Toggenburg and the Anglo Nubian, both from Europe.

Since 1983, breeders at the Naivasha substation in

Ol' Magogo have been crossing the four breeds, selecting top performers, and recrossing to get the true DPG. That final product will be a mix of the four bloodlines — what animal breeders call a synthetic.

Breeding is a long process, especially when you're selecting for the best mix of four breed traits. And at each stage, Kenyan breeders realized it was important to test crossbred animals under real-farm conditions.

Now, farmers are willing to pay to get their hands on 'one of those big bucks.'

To date more than 400 two-way crosses — goats with just one native and one exotic parent — have been given to western Kenya farmers. Although not the final DPG, these first cross — or F1 — animals are already improving the gene pool of Kenyan goat herds. In fact, animal scientists first had to search for farmers willing to try the strange goats. Now, farmers are willing to pay to get their hands on "one of those big bucks."

B.A.J. Mwandotto, animal breeder at the Ol' Magogo station where DPG breeding work has been performed for eight years.

Placing these early F1 goats on-farm also allows farmers to get accustomed to the higher management skills needed for the DPG.

These F1s grow well and give between 0.5 and 1.2 liters of milk per day more than what is needed for the kid. This milk can be used by the family or sold.

Average birthweights and meat gains are also higher for crossbred animals versus the local breeds.

Breeders in Ol' Magogo had produced 40 DPG synthetics by early 1990. These animals are being studied on the research station and on farms.

Meat production for the synthetics is near that of the original Galla, while twinning — when a doe has two kids per pregnancy — is more common than for local breeds. High twinning rates are extremely important to farmers wanting to increase herd size and to have more livestock to sell.

Researchers now need to establish the new DPG breed, study and improve its productivity, and multiply the breed in numbers large enough to distribute to farmers.

Future work

Even when the DPG is fully released, producing enough animals to meet farmer demand is slow when you follow Mother Nature's course. Breeders are now using artificial insemination to accelerate herd build-up.

With artificial insemination, more top does can be bred to a high performing buck.

Embryo transfer (ET) is also being considered as a way to speed up nature. With ET, embryos from top females are fertilized then transferred to and borne by surrogate does. ET has already been used in the beef, dairy cattle and swine industries.

Breeders use hormones to make the best females produce many more eggs than normal. These eggs are then fertilized with semen from superior males, and the embryo transferred to any healthy female. It allows breeders to get many more offspring from one genetically superior mother.

Local women are the shepherds at Ol' Magogo breeding station. The women provide dependable labor while they learn the techniques used at the station. They can then take those ideas to their home farm.

Ol' Magogo has more than 400 pure Small East African and pure Galla does. Each is a potential surrogate mother for ET.

Plans are for DPG breeders to work with the National Veterinary Research lab, Kabete, to see if ET is possible on a commercial scale in Kenya.

Long-term goals

DPG breeders will continue to refine the animal's traits during the SR-CRSP program's life. But this work should also continue after the project is complete. The breeders' long-term hope is to have the DPG recognized as a separate breed line, establish a breed society for it, and register the breed with the Kenya Stud Book and with world-wide breed literature. This would continue development of the breed and open up commercial semen and doe sales. Countries with similar conditions could then begin their own DPG herds.

Animal health — ensuring the DPG's survival

Pests and diseases flourish in Kenya's tropical climate. Through diagnostic tests and DNA mapping, SR-CRSP researchers are finding solutions to major animal health problems.

Stanley Kihara, one of four veterinary scientists at Kabete, explains a gel test used in finding a cure for contagious caprine pleuropneumonia (CCPP). It is the most serious goat disease in Kenya.

Breeding a DPG is the heart of the Kenya SR-CRSP. But good breeding alone doesn't make a healthy food production system.

Diseases and pests are a problem for any livestock enterprise. Equatorial climates such as Kenya's contribute to the growth of a multitude of pests and diseases. Management and feeding conditions there often are less than ideal.

Survival of SR-CRSP goats was critical to getting the Kenya program off the ground. From the start, veterinary researchers began working on three of Kenya's worst goat health problems: contagious caprine pleuropneumonia (CCPP), heartwater and stomach worms. While this research was funded through the SR-CRSP, findings have been used throughout the country, not just on the DPG.

CCPP — A wildfire disease

Contagious caprine pleuropneumonia is the most serious goat disease in many areas of Africa and the Middle East. It infects the lungs, weakens the animal and leads to organ damage.

CCPP is highly contagious. Once it enters the

herd, the CCPP-causing mycoplasma reproduces and spreads through the herd like wildfire. If left uncontrolled, all of the herd will contract CCPP; 70% or more will die.

Once CCPP enters the herd, the mycoplasma reproduces and spreads like wildfire. If left uncontrolled, all of the herd will contract CCPP; 70% or more will die.

Even surviving animals are weakened and highly susceptible to secondary infections.

And unlike other pneumonias, which start in weak or poorly managed animals, CCPP will cut through even the healthiest herds.

CCPP is found throughout Kenya. SR-CRSP researchers knew their DPGs would need protection from CCPP to survive.

A team of Kenyan SR-CRSP scientists at the National Veterinary Research Laboratory, Kabete, in collaboration with scientists from Washington State University, have developed a vaccine that is 100% effective against CCPP. Now this team is using SR-CRSP support to get the vaccine into farmers' hands, and to make it more economical.

Using gene mapping and recombinant DNA technologies, the Kabete scientists are closing in on the antigens that give specific resistance to CCPP.

A complicating problem for veterinarians was that they could not tell whether a sick animal had CCPP or other forms of pneumonia. The Kabete scientists used information gained during the search for a vaccine to develop a CCPP blood test.

Now, infected animals can be diagnosed in minutes. The herd is vaccinated and positive-testing animals quarantined for further care.

SR-CRSP veterinarian Donald Siamba, left, visits Bernard Kamau. Kamau, who farms less than 1/2 hectare (one acre), moved from central Kenya to western Kenya because of more affordable land. Researchers regularly visit cooperating SR-CRSP farmers to check on the health of DPG prototypes. This information helps determine which breed lines will produce the most successful DPG.

Stomach worms — Haemonchus contortus

Intestinal parasites thrive in tropical conditions, especially where general herd management is poor and where there is little or no access to deworming drugs. Haemonchus contortus is one of the worst internal parasites found in Kenyan ruminants.

Animals become infected by eating forages that contain worm larvae. Worms breed inside the animal's digestive tract and feed on blood, stealing nutrients. Even though it eats well, the goat becomes malnourished and susceptible to other diseases.

"Drench" deworming of cattle is common throughout Africa. Yet the drugs are too expensive for the lower-value goat. A farmer who can afford the treatments will invest that money in treating cattle, which are more valuable.

Some Small East African goats are resistant to the worm. Early breeding work at Ol' Magogo identified these lines and has used them to produce the F1 crossbred goats.

Work in Kabete and Ol' Magogo focuses on two ways to control the worm. The first uses DNA mapping to find the genes for worm resistance in the local breeds. Top resistant breed lines will be identified faster, and used to produce the DPG.

The second project is searching for parasite antigens to develop a vaccine against the worms. Vaccines are cheaper than continued deworming. Animals need to be vaccinated only a few times during their life.

Proper feeding can also decrease stomach worm infestations. Veterinarians at Maseno have found that cutting and wilting forages before feeding reduces stomach worm eggs.

Ticks are the carriers of heartwater disease, which can be fatal to all ruminants. A female tick, about 2 centimeters (3/4 inch) in diameter, will lay up to 15,000 eggs. It takes four months for this tick to grow from an egg to an egg-laying female.

Heartwater

Ticks are a common animal health problem. Besides causing infections in bite wounds, many ticks also carry diseases. Heartwater is one of the most fatal tick-borne diseases.

The heartwater disease organism passes from the tick into the animal's bloodstream where it weakens the blood vessel lining. Fluids leak into body cavities. Because damage is on the inside, it is impossible to diagnose heartwater by looking at the animal. Infected animals become weak and often die before they can be treated.

Farmers can ease disease pressure by keeping ticks off of the goats. Dipping animals in acaricides helps prevent heartwater and combats other tick-borne diseases. Keeping goat areas clean also helps.

But ticks don't live on goats alone. Rodents and wildlife carry and spread them. Females of the tick that carries heartwater lay up to 15,000 eggs each.

Again, using DNA fingerprinting, SR-CRSP researchers are fine-tuning a test to diagnose heartwater. They will also use DNA information to develop a vaccine against the disease.

Nutrition and health for goats and people

In the past, Kenyan farmers often had to choose between feeding their families or their livestock. Thanks to research by SR-CRSP forage agronomists and animal scientists, farmers can grow crops for livestock alongside food for the family.

Most farm families in western Kenya have only 2 hectares to produce their entire food supply. It's not easy to convince a farmer to forsake more land to grow forages for livestock when the family is barely being fed.

Forage agronomists and animal scientists have looked for low-cost or no-cost ways to answer this dilemma. They've found forages and foods that grow side by side, and have looked for crops which feed humans and animals.

Such holistic research takes place on a 1/2-hectare (1 1/4-acre) model farm in Maseno. The farm is based on white maize (corn) which is the staple crop on Kenyan shambas. Families roast fresh ears for eating and dry kernels for cornmeal. The meal is made into ugali, a porridge that is the backbone of a rural Kenyan's diet.

So the first goal of the model farm was to develop forages without eating into maize growth.

On half of the plot, maize is planted in wide rows. Forages including napier grass and the legumes luecaena, sesbania and calliandra are planted in alleys between maize rows. The other half of the plot contains sweet potatoes, another common food crop in Kenya. The entire model farm plot is surrounded by a 2-meter (7-foot) border containing a mix of the legumes and napier grass.

During the year, farmers harvest legumes and napier as needed. Good rainfall allows these crops to regrow after each harvest for a continuous animal feed source.

White maize is the staple food for most Kenyan families. Fresh maize is roasted while dried kernels are ground into meal. Maize leaves and stover are used as a forage for livestock.

Tethering is a common feeding method in areas of western Kenya where grazing land is available. Goats are allowed to graze in a circle for portions of the day, then are taken back to the farmstead. Joshua Abikoke, one of the early project cooperators tethers one of his goats on a back area of his 2-hectare farm.

Sweet potato vines are fed as a supplement to kid goats. Kids fed sweet potato vines — in addition to their mother's milk — grow as fast as kids fed milk alone, yet the family can harvest up to a liter of milk daily.Vines can also be wilted and fed to adult goats.

Sweet potato tubers are eaten by family members.

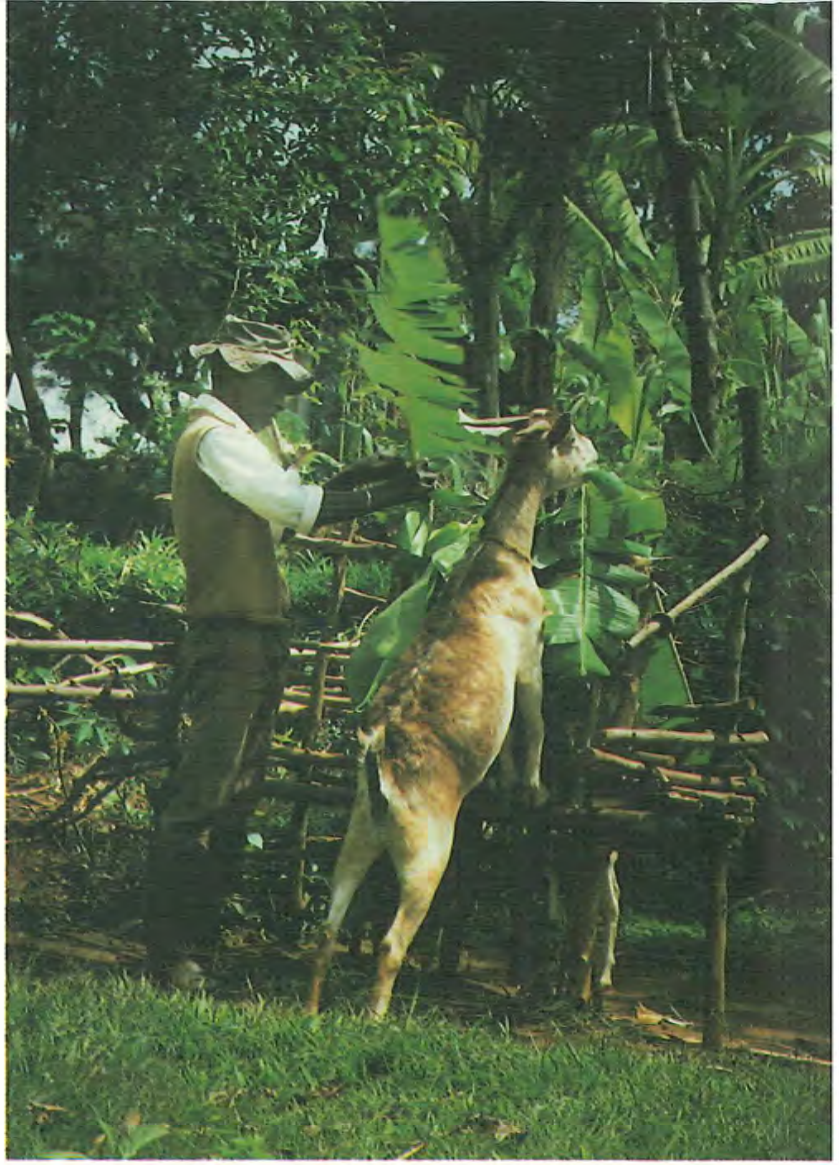
Maize is harvested traditionally. Maize leaves are fed to goats once the ears are mature enough for roasting. Leaves from a 1/4-hectare maize plot can feed 2 milking does for three months.

Feeding on the model farm is based on zero- and limited-grazing, approaches common on Kenyan shambas with goats.

In true zero grazing, animals are penned and all feed is brought to them.

Most western Kenyan farmers practice limited grazing. For this method, goats are tethered to a stake, giving them a limited grazing area. Some forages are carried to the tethered goats.

This approach is popular in western Kenya for several reasons. Few farms have access to large grazing areas. In families where the husband works off-farm, no one is available to watch free-grazing animals. With zero grazing and limited



Joshua Abikoke built this goat feeder to reduce feed waste. It is built high off the ground to simulate the goats' natural browsing.

tethered grazing, women can feed animals near their house.

The feeding system is intensive, and requires careful management and a lot of labor. But researchers say the model farm will feed a family and four goats, with much better family nutrition than if the family grows maize alone.

The model farm system has spawned a few pleasant surprises. While researching sweet potatoes, agronomists wanted cultivars with a balance of high tuber production for humans and many vines for animal feeding.

Then agronomists took the holistic approach another step. They asked local women to taste-test promising cultivars.

By chance, the women's favorite has the high tuber-vine balance agronomists were looking for. It is now grown on many farms.

Luecaena and sesbania also serve a dual purpose on the DPG model farm. These two legumes form trees six inches in diameter in about 3 years. Tree leaves are fed to livestock, while the tree eventually supplies wood for fuel. Leaf litter and tree roots also improve the soil where these legumes are planted.

Model farm scientists now are working with farmers to synchronize animal breeding and forage growth to make the most of the available feeds.

If does are bred in January they can be fed a napier/luecaena mix during gestation. When they give birth, maize leaves will supply a high-protein forage for milk production. Maize can be harvested normally. Later, maize stalks will be fed to does.

Manure gives goats a *triple* purpose

Researchers have found that a linchpin of the model farm system is the goats themselves.

An average DPG doe produces 130 kg (286 pounds) of manure annually.This manure is invaluable to farmers who can't afford commercial fertilizer and, because of small farm size, can't raise cows.

Sesbania plants are an important legume in the model farm system. A Maseno farm worker waters seedling plants in the farm's "greenhouse," the shelter of a sprawling eucalyptus tree.

Cut-and-carry feeding is another popular method for feeding goats in Kenya. Maize stover or other forages are carried to where goats are confined. While this requires more labor than tethering, it reduces wasted feed and also keeps goat manure in a concentrated area. The manure, invaluable as fertilizer, can then be collected and applied to crop fields or composted with crop residue.

Maize grown continuously on the same plot depletes soil fertility and enhances soil erosion. The land becomes prone to weeds and other pests.

Maize grown in overcropped fields produces few edible ears.

With goat manure, and nitrogen from the legume alley cropping, farmers can double maize yields.

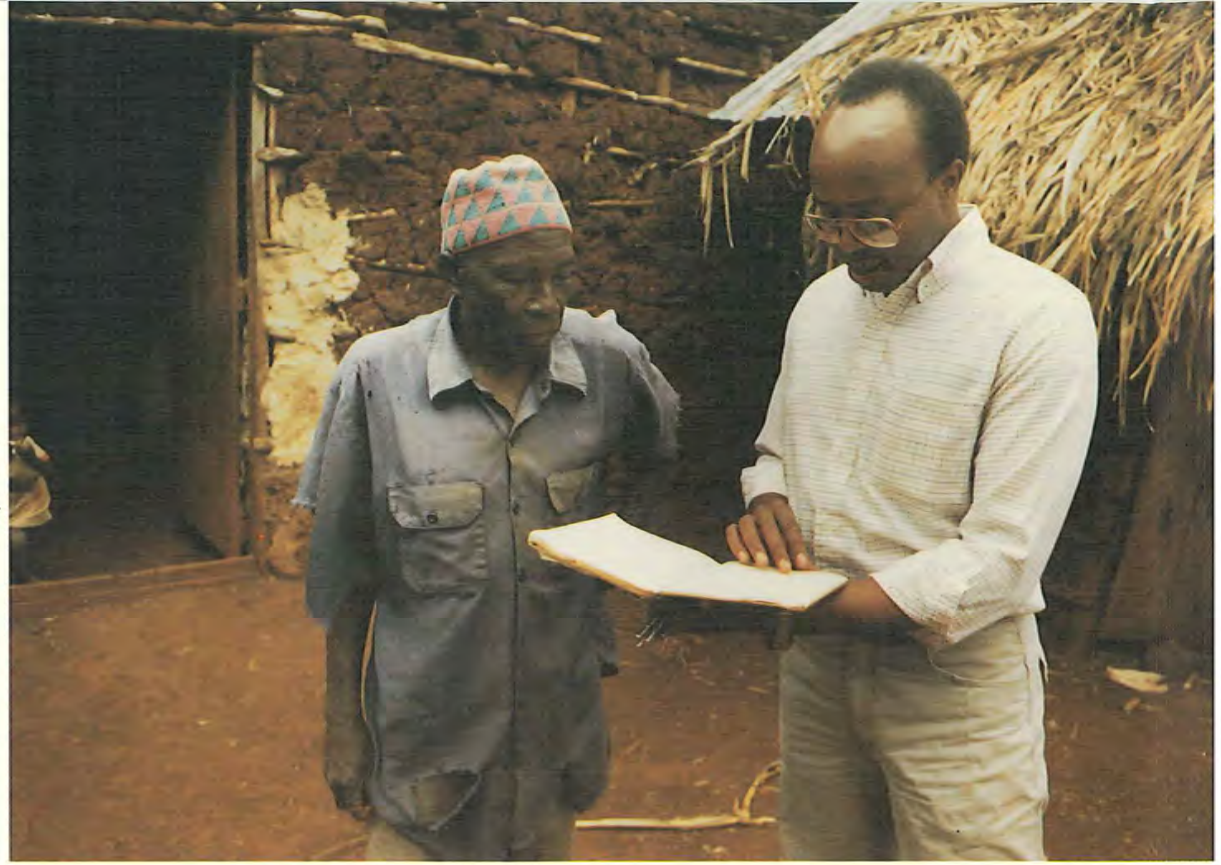
Trials showed goat manure has a significant yield advantage over chemical fertilizers. Manure helps balance soil pH, while commercial fertilizer alone makes soil too acidic for optimum production.

Limited and zero-grazing programs help farmers capture most of the goat manure. It is then applied in the field or composted with leftover maize stalks.

Kenyan researchers say the DPG, because of its manure, should be called a *triple*-purpose goat.

Social and economic issues of change

A sensitivity to strong traditions and social forces has increased acceptance of the DPG and other model-farm ideas.



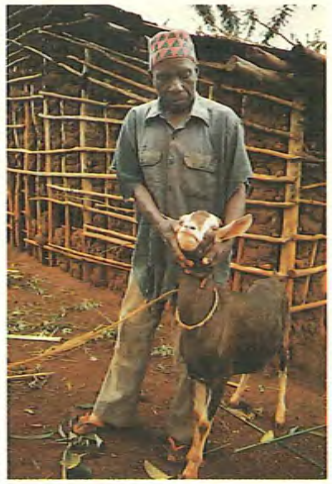
Nkonge Mbabu, resident rural sociologist, meets with farmers such as Andrew Andira on a regular basis to discuss SR-CRSP recommendations. Below, Andira with one of the forerunners of the DPG.

Smallholder farmers aren't immune to the realities of the profit margin. Before they consider a new enterprise, or improve an old one, farmers must consider several factors:

- Does this new way cost too much up front?
- Can I afford to maintain the technology?
- Do I have enough labor to handle this and current chores?
- Will profits from the new method be eroded by losses from current crops that I can no longer tend to, or because I must quit an off-farm job?

Farmers also may not adopt economically viable ideas if the recommendations are socially unacceptable.

These questions and potential problems have made the study of economics and sociology a



critical part of every SR-CRSP project, including that of the Kenyan DPG.

DPG economics

From its inception, the DPG was expected to do two things: provide adequate meat and milk from one efficient animal; and provide excess milk and animals for sale. But it was critical to see that when all aspects of DPG management were taken into account whether the system would actually "pay off" for Kenyan farmers.

Agricultural economists, Kenyan and American, began studying DPG production in western Kenya in the early 1980s. They looked at labor needs, cost of seed, fertilizer and animal medicines, and the trade-offs of accepting the feed, health and management needs of the DPG.

They examined the profitability of each step in the DPG system. For example, they examined the benefits of farmers' adopting recommended forages, or increased use of fertilizers, but not adopting the DPG.

This work was important because of the on-farm nature of the SR-CRSP.

By asking these questions, economists helped the other SR-CRSP scientists develop forages and animal care ideas that farmers could use immediately, without waiting for the DPG to come along.

SR-CRSP scientists shared findings with farmers as those ideas were found. This kept the scientists from dumping an entire foreign production system on farmers at one time.

Scientists developed forages and animal husbandry ideas that farmers could use immediately, without waiting for the DPG to come along.

Average smallholder income in western Kenya in 1985 was 4,198 Kenyan shillings (Ksh), or about U.S. $262. Sources were 25% from crops, 10% from livestock and 66% from off-farm income.

Economic modeling shows that where farmers have enough land to support DPG forage programs, farm income potentially increases by Ksh 11,887 or about $525.

The increase comes from a combination of factors. With fewer animal deaths and higher weight gains, farmers should have more, bigger animals to sell. The goats' increased milk production should replace milk currently bought in local markets or from neighbors, which reduces food expenses.

The increases assume above-average management.

Economists also found that credit availability can further increase income from the DPG system. Farms with 1.19 to less than 2 cultivated hectares produce an average net income of Ksh 11,906 with no credit. Income rises to Ksh 20,131 if the farmer can borrow Ksh 1,637 for more crop inputs.

Economic models show that larger farms earn even higher returns with minimal borrowing.

Credit, however, remains a rare commodity for subsistence-level Kenyan farmers.

Sociological factors

With today's technology, scientists can improve almost any animal or crop system. But strong cultural traditions or other social forces can cause even the brightest solutions to wither in some technical journal.

They knew milk production was needed, but weren't sure if a pure dairy goat was the answer.

The first question the Kenya SR-CRSP team needed to answer was what type of goat would be best for western Kenya.

They knew milk production was needed, but weren't sure if a pure dairy goat was the answer.

Early sociological studies in the area showed an exotic dairy goat would be impractical. Inhabitants were subsistence farmers. Funds and markets weren't available to support a commercial-type dairy

Women are often left to manage the farms while husbands work off-farm. Leya Omaro manages the 1-hectare (2-acre) farm that supports her 10 children.

goat. Extension personnel in the area didn't have the support or commercial dairy training to help farmers keep large numbers of dairy goats alive.

This substantiated the need for a DPG. An animal with a high percentage of local bloodlines would survive better under these conditions. And a dual-purpose, meat/dairy animal would better improve nutrition and potential income for farms in the area.

Since then, sociologists have continued to study the impact, and relevance, of recommendations made by SR-CRSP scientists. Sociologists found that in the western highlands, where land pressure is greatest and farms the smallest, farmers accept the recommended limited-grazing strategy.

The case is different in the western Kenya lowlands. Here, farms are larger. Many farmers own one or two cows that they must take to grazing areas. It makes more sense — in labor terms — for farmers to take the goats along, rather than to return home to hand-feed them.

Sociologists found that labor is a limiting factor on subsistence farms where men travel to large cities to earn off-farm income.

Children are usually at school during most daylight hours. Women are often left with the day-to-day farm chores in addition to household activities such as storing and preparing food and gathering water and firewood. Even with zero grazing, the daily feeding, watering and animal care can overwhelm these women.

A complete DPG system with four or more goats may not work on these farms. But if only a few of the milk-producing animals can be kept, family nutrition will improve.

Research teams at Maseno are now working with 150 farm families in western Kenya. The SR-CRSP supplies goats and model-farm information while the farmer agrees to weekly interviews. These discussions help researchers find out which management practices are working, and which aren't, in that farmer's area. With this constant monitoring, the DPG program changes and grows.

Getting research out on the farm

Demand for information about the model farm programs continues to increase. To reach more farmers, scientists are compiling their recommendations for the DPG system into a technical publication.

On-farm research and getting successful ideas out to all farmers are a cornerstone of SR-CRSP programs. As word of the Maseno model farm programs spreads, farmers throughout the region have wanted to know more.

SR-CRSP team members are now putting together a technical publication — a tech pack — describing recommended practices for the DPG system.

The tech pack includes both standard recommended management practices, as well as ideas for more advanced forage and animal management. Upper management ideas include practical ways of ensiling forages, advantages of drying and storing hay, and building confinement houses for goat feeding.

Tech packs are to be distributed to extension agents and farmers throughout western Kenya and similar areas. Extension and SR-CRSP team members can visit farmers periodically to help them fine-tune the practices for their farm.

Animal health is as important on-farm as it is on the research stations. Workers such as Astone Asitiba are trained to visit SR-CRSP farmers weekly. They advise cooperating farmers on treating goat diseases and pests, and record the goats' meat and milk production. They collect data on how families adapt the model farm system to their farm and on the nutrition of both the animals and the family members. Asitiba and his coworkers were trained at the SR-CRSP model farm research station in Maseno.

The visits also show which practices don't work in a given area. This communication between farmer and researcher is one of the best sources for updating the research and the tech pack itself.

The Maseno model farm also has field days throughout the year, where farmers are invited to come see the practices in operation. It's all meant to get research findings out on the farm — where they're supposed to be.

The tech pack is written in four languages: English and Kiswahili, Kenya's two official languages; and in Luo and Luhya, dialects common to western Kenya. Illustrations show new feeding and animal care techniques for the DPG.

The Kenya SR-CRSP — a beginning

The benefits to Kenyan farm families from SR-CRSP research extend well beyond the boundaries of the DPG program.

No single development program can save a country from hunger.

Yet the Kenya SR-CRSP is making a difference. The DPG project has already improved the nutrition and income of about 150 western Kenya farm families. When you visit those families, you feel their enthusiasm and excitement. They want to make the model farm system work.

And the SR-CRSP should have farther-reaching influence as well.

The crossbred and composite goats — the grandparents of the true DPG — have improved the gene pool of Kenyan goat herds. That improvement will remain even if the project is stopped tomorrow.

Perhaps the most lasting contributions are to the face of Kenyan agriculture and agricultural research.

Forage production systems from the Maseno model farm are being adopted by farmers to feed non-DPG goats and even cattle. Disease research, done with help of KARI and the Ministry of Livestock Development, is solving animal health problems that have world-wide ramifications.

With land so scarce, Kenyan farmers cannot waste even minute amounts of animal feed. SR-CRSP researchers found that goats waste less feed if they are fed from above, which mimics the goats' natural browsing, instead of being fed on the ground. This and other DPG methods can also be used with non-DPG goats.

Institutions have also gained from SR-CRSP work in Kenya. Breeding projects at Ol' Magogo have strengthened the small ruminant component at the National Animal Husbandry Research Centre. Now a former empty field contains buildings and equipment for continued goat and sheep research. SR-CRSP research has also helped strengthen the small ruminant research program at the Kabete veterinary center.

DPG and farming systems research has served an educational purpose as well. To date, project research has helped Kenyan students earn 3 bachelors degrees, 25 masters degrees and 5 doctoral degrees. These graduates will continue to make research findings in Kenya and the world over.

So perhaps the DPG will only be a small contribution to the overall scope of Kenyan agriculture. The real hope is that the institutions, knowledge and systems that have been set in place will continue to aid small ruminant and other research long after the SR-CRSP project is completed.

An Overview of the SR-CRSP

The origins of the Small Ruminant Collaborative Research Support Program (SR-CRSP) lie in the passage by Congress in 1975 of the Famine Prevention and Freedom from Hunger Act. The provisions of Title XII in the Act were to:

> *". . . strengthen the capacities of U.S. land grant . . . universities in program-related agricultural institutional development and research . . . improve their participation in the U.S. government's international efforts to apply more effective agricultural sciences to the goal of increasing world food production, and in general should provide increased and longer term support to the application of science to solving food and nutrition problems of the developing countries."*

In this simple but eloquent language the key elements that have been instrumental in molding the design, goals,and administration of the SR-CRSP were finally established. Specifically:

- To strengthen capacities of U.S. universities as opposed to conducting research exclusively overseas.
- To conduct institutional development and research as opposed to direct handouts in the form of commodity transfer.
- To supply increased and long term support as opposed to small, short term, stop-and-go projects that have characterized so much of the past technical assistance to developing countries.

The institutions involved in this research are varied. The U.S. institutions that comprise the SR-CRSP are: University of California, Davis; Colorado State University; University of Missouri-Columbia; Montana State University; North Carolina State University; Texas A&M University; Texas Tech University; Utah State University; Washington State University; and Winrock International Institute for Agricultural Development. The institutions that collaborate with the SR-CRSP overseas are: Agency for Agricultural Research and Development, Indonesia; Kenya Agricultural Research Institute, Kenya; and Institut Agronomique et Veterinaire, Hassan II University of Morocco. In 1987 the SR-CRSP moved into linkage status with Brazil and in 1990 the same process occurred with Peru. Currently, the SR-CRSP is in the midst of negotiating a Memorandum of Understanding with the Government of Bolivia to work with the Instituto Boliviano De Tecnología Agropecuaria. Research should begin in Bolivia in 1991.

Nearly 95 percent of the world's half billion goats are in the developing countries. They are the primary source of milk and meat for the disadvantaged who live in harsh environments that are subject to drought and often seriously eroded lands. Following more than ten years of research and training of scientists from these regions, the SR-CRSP has reached the stage of payoff in very positive results in human terms. Millions of smallholders and their families are now benefiting from efforts which have built on the base of knowledge found in the U.S. and other developed countries. When adapted to the unique situation of developing countries, this has made possible advances that otherwise would have taken decades to achieve.

But in the final analysis, probably the most important achievement of the SR-CRSP has been the training of highly qualified scientists from developing countries. They in turn, have been able to influence the development of their own scientific and educational institutions. Throughout this process, a worldwide network of scientists has emerged who can communicate new scientific discoveries from country to country with the speed of electronic transmission. In the truest sense, there now exists a global partnership in research that promises a better life for millions of people.