

CONSIDERATIONS FOR ON-FARM RESEARCH AND DEMONSTRATION
OF USEFUL FEEDING/NUTRITION PRACTICES FOR SMALL
RUMINANTS IN ETHIOPIA

[CONSIDERACIONES PARA LA INVESTIGACIÓN EN GRANJA Y LA
DEMOSTRACIÓN DE PRACTICAS NUTRICIONALES/ALIMENTICIAS
ÚTILES PARA PEQUEÑOS RUMIANTES EN ETIOPIA]

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SUMMARY

Many funding organizations view on-farm research as having greater impact than 'on-station' trials, a feeling shared by farmers and pastoralists because of the opportunity to see and evaluate findings first-hand. Langston University provides technical assistance in a 5-year project supported by the U.S. Agency for International Development, entitled Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP), which includes on-farm research and demonstrations of useful feeding/nutrition practices. The ESGPIP partners with research and extension entities throughout Ethiopia in implementing specific activities. One effective strategy in on-farm research and demonstrations used by some partners involves group management of animals by Farmer Research Groups (FRG) situated in different villages. Four or five FRG have been used by ESGPIP implementing partners, with each consisting of 9 or 10 farmers contributing 3 or 6 animals. Funds were provided to construct a simple barn with three pens (10 animals per pen) at each FRG for group housing and feeding at night. One or two animals per farmer were subjected to each of three feeding treatments. Conversely, in other settings treatment imposition on individual farmers and their animals in multiple communities was most suitable. Both approaches allow for statistical analysis of data, desirable for publication of the findings and, perhaps more importantly, true value or meaning of any differences noted. With use of farmer-owned animals in some instances it may not be feasible to impose negative control treatments, but an appropriate common or standard supplemental feedstuff treatment allows for an adequate basis of comparison. For sustainability, on-farm research should include input by and intimate involvement of producers and participation of local technology transfer personnel.

Key words: *Research, on-farm, demonstration, extension, technology transfer*

1. INTRODUCTION

The impact of on-station research depends on the accuracy of simulating 'on-farm' conditions and effectiveness of extension efforts to transfer knowledge generated to farmers, which includes potential practical and economic benefits. Even with strong evidence for gain from adopting a particular technology identified, developed, and evaluated on-station, on-farm demonstrations may still be required to convince farmers and so that required knowledge necessary for successful implementation is acquired. Moreover, in some cases there are conditions on-farm not previously realized or adequately considered on-station. Therefore, in terms of efficiency of utilization of resources and time, whenever possible on-farm research offers many attributes. The objective of this short communication is to discuss some of the different approaches in on-farm research and demonstrations of a project entitled "Ethiopia Sheep and Goat Productivity Program" (ESGPIP), supported by the U.S. Agency for International Development (USAID) and with technical assistance provided by the American Institute for Goat Research (AIGR) of Langston University.

2. VARIOUS APPROACHES

2.1. Introduction

Means of conducting on-farm research and demonstrations vary with the nature of the intervention, characteristics of farm/pastoralist households such as cultural practices, cohesiveness of agricultural communities, and cooperativeness of farmers/pastoralists with others in a group and individuals or institutions wishing to introduce new

technologies. A factor influencing the type of approach taken is prior research and existent knowledge. Considerable research with some technologies may already have been performed, requiring only demonstration for successful integration into present farming systems. In other cases it may be necessary to exhibit benefits of an intervention compared with conventional practices, along with evaluation of different means of applying new technologies.

2.2. Collaboration with implementing partners

Because of the large number and broad array of activities of the ESGPIP, there is collaboration with numerous organizations and institutions in Ethiopia. Among them are national and regional (i.e., similar to states in the U.S.) research and extension divisions and universities with agriculture and animal science emphases. In order to work with these implementing partners, in many cases more than one for a specific activity, the first step is to communicate areas to be addressed, types of approaches necessitated in ESGPIP Annual Work Plans, and the range of fund availability. One donor requirement is that all or most activities occur on-farm rather than on-station. The activities must encompass means of dissemination such as field days and intimate involvement of extension personnel. In particular, Kebele Development Agents (KDA) have active roles. KDA are somewhat similar in concept to county extension agents in the U.S., although kebeles are smaller in size. There is a major component of the ESGPIP devoted to training of KDA in sheep and goat production. Relatedly, efforts are made to involve KDA in all other ESGPIP areas of intervention (i.e., feeding practices, breed improvement, external parasite control, and health management).

In some countries 'Request for Proposals' or 'Request for Applications' can simply be advertised, such as on the internet, followed by submission of many more proposals than could be approved and supported given the availability of funds. This method was initially tested to a limited extent by the ESGPIP, but was not found to be highly effective in this scenario. Thus, to initiate the desired collaborative activities, ESGPIP personnel make one or more site visits for an introduction and discussion of potential activities and collaboration, along with multiple follow-up phone conversations. The implementing partner then submits an Activity Description (i.e., proposal). The Activity Description and associated budget are reviewed and suggestions for revisions are given. In most instances a revised proposal is received and approved, subsequent to formation of an official cooperative agreement or subcontract for fund transfer to the implementing partner.

Striving for sustainability, ESGPIP activities are participatory, with farmers/pastoralists providing essential inputs, such as labor, animal use, etc., and in some cases sharing in cost of purchased items such as supplemental feedstuffs. Typically, the ESGPIP funds items such as supplemental feedstuffs, seeds, fertilizer, animal management supplies, per diem for data collection, field days, etc. An important component of the on-farm research activities that the ESGPIP insists upon and provides technical assistance for is use of a questionnaire to thoroughly characterize production conditions and practices of the participating farm/pastoralist households. An ability to statistically analyze data derived on-farm is viewed as desirable for publication of the findings for broadest possible dissemination and, perhaps more importantly, true value or meaning of any differences noted.

2.3. Farmer Research Groups

One approach in on-farm research and demonstrations is use of Farmer Research Groups (FRG). Two institutions employing this method are the Adami Tulu Agricultural Research Center (ATARC; in the Oromia Region) and Department of Animal Science of Hawassa University (HU; in the Southern States and Nationalities Peoples Region). At both sites FRG had been formed and collaborated with previously, although states of existence or organization differed. For the ATARC, similar earlier on-farm research had been conducted with these particular FRG. For HU, women's groups had been formed in select villages for training in goat production and participation in a goat distribution development program in a past collaborative project with the AIGR. The FRG approach requires farms and farm families in relatively close proximity to one another, trust, an ability to work effectively together, and conducive cultural conditions.

An important component of any on-farm activity is farmer/pastoralist household selection. This is somewhat less of an issue with existent FRG that have been previously involved in on-farm research and demonstrations, although there still may be particular households to be added or excluded based on previous performance, interest, willingness and ability to perform required activities, stature in the community, etc.

In the first trials conducted, there were five and four FRG at ATARC and HU, respectively. Each FRG included nine or ten farm households that contributed three or six goats to the trial, resulting in 30 animals per FRG. Households hosting the animal barn and primarily responsible for night management were allowed to contribute six animals rather than three. The very simple and inexpensive barn with three pens was constructed by farmers of each FRG from locally available materials, with a small amount of funds for

some items provided by the ESGPIP through the subcontract agreements. Barns were located at most progressive households, although at one site it was situated at a Farmer Training Center (FTC) used for farmer training by KDA. Field days were conducted with assistance of the ESGPIP.

Three treatments were imposed by the ATARC and HU. ATARC treatments were supplementation with wheat bran mixed with 1) linseed meal, 2) noug cake, and 3) formaldehyde-treated noug cake. Treatments for HU were ad libitum access to 1) deep-stacked broiler litter, 2) a mixture of 40% corn and 60% broiler litter, and 3) a mixture of 40% corn and 60% linseed meal. Late in the afternoon until the morning, one animal per household (two in some cases for the household primarily responsible for night management) resided in one of the pens and received the feeding/supplementation treatment. Households rotated in duties of supplement feeding and care during daytime grazing. Supplemental feedstuffs and a simple scale were provided. Frequent visits by personnel of HU and ATARC occurred to ensure that feeding and other management practices were carried out properly. Body weight and condition score were periodically determined by ATARC and HU personnel. Assistance was provided in marketing of animals for greatest economic returns. For example, the ATARC field day was attended by export abattoir personnel, resulting in abattoir purchase of these animals the following week at a premium price. A partial budget analysis addressing economic return differences among treatments was conducted.

For extrapolation of group management trials to native farm settings, conditions must not markedly deviate. In the ATARC and HU activities, only group supplementation and housing at night differed from standard practices, since animals of these FRG or villages graze together or in close proximity on similar vegetation together during the day. In neither of these trials was it possible to include a non-supplementation or negative control treatment, which would have been desirable to most effectively evaluate economic returns. Thus, the economic analysis of treatments depends primarily on inclusion of common, conventional supplemental feedstuffs for contrasts. A notable attribute of this FRG approach is a strong method of statistical analysis. Sources of variation, appropriate error terms, and degrees of freedom for HU and ATARC trials are given in Table 1.

2.4. Individual farmers

A number of on-farm research/demonstration activities of the ESGPIP involve animal management by individual farmer/pastoralist households, in slight contrast to group management employed by FRG of

HU and ATARC. But, in other aspects the approaches are quite similar. A possible advantage of individual farmer use is that management is less altered than with FRG, though again, the deviation is minimal.

Tigray Agricultural Research Institute. The Tigray Agricultural Research Institute (TARI) is conducting two on-farm research/demonstration trials regarding diet quality. In both trials participating households were in two woredas, each with two kebeles. An average number of kebeles per woreda is 25. Six households were selected per kebele. Selection was performed by TARI personnel, woreda extension officers, and local KDA. Before activities began, farmers were trained in a variety of areas, including animal care, urea treatment of crop residues, and forage planting and conservation. Personnel of TARI and woreda extension officers, along with KDA, were responsible for data collection. The Relief Society of Tigray provided financial loans to some farmers for animal purchase. As a general policy, the ESGPIP does not provide funds for animal purchase by farmers, with farmer resource and time input a requirement. Each farmer contributed three animals, for totals of 18 per kebele, 36 per woreda, and 72 per trial. The two treatments in trial 1 were ad libitum offering of millet straw alone or with a supplement of straw treated with urea and molasses offered at 0800 and 1600 hours. Treatments in trial 2 were consumption of untreated straw alone or with cactus plus lablab or straw treated with urea and molasses.

In contrast to exposure of at least one animal per household to each treatment in HU and ATARC trials, in TARI trials three of the six households per kebele were on the two treatments of trial 1 with two treatments, and two households per kebele were on the three treatments of trial 2. With these conditions, an appropriate statistical analysis is shown in Table 1.

Ambo College of Agriculture. An activity conducted at Ambo College of Agriculture (ACA) is somewhat similar to those performed by TARI, but with some important differences. As for TARI trials, due to factors such as farm size and distance between farms within kebeles, a FRG approach used by ATARC and HU was not feasible. Initially the ACA activity was to involve a total of 150 farm households with 30 households in each of five kebeles, although actual numbers were slightly less. Woreda extension officers and 10 KDA serving these villages were involved in household selection; KDA participated in implementation and monitoring of day to day activities, data collection, and organizing the field day.

Training was provided to farms in advantages of management practices such as creep (supplementation of suckling animals) and post-weaning

supplementation, feeder and feeding pen construction, animal care, and use of volumetric methods to weigh offered and refused supplement. Each farmer had 2-10 sheep, goats, or a mixture of sheep and goats. Approximately 25 farms per location received a supplement primarily composed of wheat bran and noug cake given to lambs and(or) kids, and five did not supplement (control). Supplement consumption was *ad libitum* or nearly so. Initially supplement was offered to each animal at 50 g/day, gradually increasing to 300 g/day. Control farms were provided with the same amount of supplemental concentrate as other farms, although the feed was not used for animals in the trial. The trial began at 1-2 months of age and ended at 6-8 months. Supplement was given twice daily, early in the morning and late in the afternoon. Animals grazed and(or) were fed straw during the day. The trial began in the latter part of the rainy season and extended well into the dry season, during which time the availability of low-quality forage was limited. Simple pens and feed troughs were constructed from local materials, with only supplies such as nails provided by ACA and the ESGPIP. Measures included supplement intake, body weight of females and young, and body condition score of females. A partial budget analysis was conducted following assistance provided in marketing many of the animals near the Easter holiday season.

In this and other activities, it is desirable to conduct activities at multiple sites rather than one. One site may limit conditions to which findings can be applied. An example of the utility of multiple sites was noted in the ACA activity. The villages were located on the downslope of a hill. Early in the trial, internal parasitism was encountered, with the severity corresponding to position on the hill. Lowest villages with wettest conditions had most significant problems, whereas the highest villages encountered little or no evidence of internal parasitism. Assuming 30 households per village and that each household had two animals, sources of variation, error terms, and degrees of freedom for one method of analysis are shown in Table 1. Gender, litter size, and use of one vs. two species might also be considered in the statistical analysis. A disadvantage of the relatively small number of households on the control treatment is weakness of the statistical comparison of the supplementation vs. control treatment. Another consideration for the statistical analysis is that species was not balanced across locations or farms, resulting in use of residual error to test for effects of species and interactions with location and treatment.

Andassa Livestock Research Center. The Andassa Livestock Research Center (ALRC) near Bahir Dar of the Amhara Regional Agricultural Research Institute performed a research/demonstration activity comparable in design and most other aspects to that

conducted by the ACA. However, one species was addressed, the number of observations was somewhat more similar among treatments, and there was not a control treatment without supplementation. An attempt was made to include a control treatment, but because a large number of farmers used their own funds to purchase male sheep for the trial, few were willing to participate without supplemental concentrate provided. Use of FRG with supplementation on a group basis was contemplated; however, there was concern about animal theft expressed by farmers. Also, cultural considerations were important as well, as women in this area typically spend the day at home tending to chores such as animal care. Training in feeding and animal care was given to women, who were primarily responsible for day to day management. Although, the initial discussion regarding participation and purchase of animals by households when necessary involved both women and men.

There were five participating kebeles, each with 6-10 farm households contributing three young sheep. Some of the farms within kebeles were located a considerable distance from one another. In such situations, rather than choice of a unit such as a kebele, it is desirable to first assess the study area and categorize in terms of farming communities with similar conditions and production practices. This might result in categorizations of multiple farming communities within kebeles or farming communities consisting of households in two adjacent kebeles. Although, the latter scenario could complicate involvement of KDA.

A total of 44 farm households participated, with 13, 16, and 18 subjected to the three treatments. Two to four households per village were assigned to the three treatments for a 3-month period scheduled for animal availability for sale near the Easter holiday season. Most of the experiment was conducted during the dry season, with limited availability of low-quality forage. The treatments were designed to evaluate the effect of untreated finger millet straw offering compared with grazing alone given a moderate level of concentrate supplementation and the feasibility of a lower level of concentrate supplementation with use of ammoniated versus untreated straw. Treatments were feeding of 1) a wheat bran-noug cake mixture at 400 g/day (dry matter) per animal plus grazing, 2) 400 g/day (dry matter) of the concentrate supplement plus untreated finger millet straw, and 3) 300 g/day (dry matter) of concentrate plus straw ammoniated via urea treatment and with molasses before urea treatment. A method of statistical analysis is given in Table 1.

As for other activities, KDA collaborating with personnel of ALRC were responsible for day to day management, including animal weighing. Households

were given an appropriately sized plastic water bottle for delivering supplemental concentrate. Untreated and treated straw when provided were offered for ad libitum consumption. Every few days KDA visited farms and weighed a bag of straw for farms on those treatments sufficient for feeding the next few days. This also minimized the number of times pits with treated straw were opened. Unfed straw in bags from the previous visit were weighed to estimate the amount offered. Likewise, refused straw was collected daily by the households, bulked, and stored for weighing by KDA. Samples of straw to be fed and refused were taken on multiple days for estimation of average dry matter concentrations.

CONCLUSIONS

On-farm research should be conducted in a manner allowing statistical analysis, so that differences are indeed real, and for widespread dissemination of findings in addition to local information transfer. Management and treatment imposition at different sites on groups of animals from a number of producers is possible in some locations, providing a favorable means of statistical analysis. Although, conditions should not markedly deviate from normal production practices. In other settings, it is most feasible to allocate treatments to individual farm/pastoralist households, with notable benefit realized from consideration of multiple sites. For sustainability, on-farm research should include input by and intimate involvement of producers and participation of local technology transfer personnel.

Table 1. Sources of variation, error terms, and degrees of freedom for on-farm research and demonstration activities with small ruminants in Ethiopia

Site ¹	Source of variation ²	Error term	df ³
ATARC	Treatment	Treatment x FRG	2
	FRG	Treatment x FRG	4
	Treatment x FRG	Farm(FRG)	8
	Farm(FRG)	Residual	45
	Residual error		90
HU	Treatment	Treatment x FRG	2
	FRG	Treatment x FRG	3
	Treatment x FRG	Farm(FRG)	6
	Farm(FRG)	Residual	36
	Residual error		72
TARI, trial 1	Treatment	Treatment x woreda	1
	Woreda	Treatment x woreda	1
	Treatment x woreda	Kebele(woreda)	1
	Kebele(woreda)	Residual	2
	Treatment x kebele(woreda)	Residual	2
	Residual error		16
TARI, trial 2	Treatment	Treatment x woreda	2
	Woreda	Treatment x woreda	1
	Treatment x woreda	Kebele(woreda)	2
	Kebele(woreda)	Residual	2
	Treatment x kebele(woreda)	Residual	4
	Residual error		12
ACA	Treatment	Treatment x village	1
	Village	Treatment x village	4
	Treatment x villaje	Residual	4
	Species	Residual	1
	Treatment x species	Residual	1
	Village x species	Residual	4
	Treatment x village x species	Residual	4
	Residual error		280
ALRC	Treatment	Treatment x kebele	2
	Kebele	Treatment x kebele	4
	Treatment x kebele	Residual	8
	Residual error		30

¹ATARC = Adami Tulu Agricultural Research Center; HU = Hawassa University; TARI = Tigray Agricultural Research Institute; ACA = Ambo College of Agriculture; ALRC = Andassa Livestock Research Center.

²FRG = farmer research group; kebeles can be considered villages; woredas are composed of a number of kebeles

³df = degrees of freedom

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