REPRODUCTIVE PERFORMANCE OF SMALL RUMINANTS IN AN OUTREACH PILOT PROJECT IN WEST JAVA

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ABSTRAK

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Kinerja reproduksi ternak ruminansia kecil telah dievaluasi dalam penelitian lapang (on-farm) yang dilakukan dengan pendekatan multidisipliner, yang dikenal sebagai *outreach pilot project* (OPP), yang melibatkan petani peternak di pedesaaan Jawa Barat, Indonesia. Strategi untuk meningkatkan produksi ternak ruminansia kecil dilakukan dalam proyek penelitian ini. Data pemantauan selama tiga tahun (1986-1987, 1987-1988 dan 1988-1989) menunjukkan peningkatan yang nyata pada jumlah ternak yang dipelihara petani peternak. Rataan jumlah induk yang dipelihara per peternak per bulan (EA) sebesar 4,1. Meskipun pada peternak yang memelihara ternak domba dengan jumlah yang relatif besar, rataan kinerja reproduksinya lebih rendah, tetapi beberapa peternak ini menunjukkan bahwa kinerja reproduksi dan produksinya sangat baik. Sekitar 28% peternakan yang diamati mempunyai rataan selang beranak (LI) 10 bulan dengan potensi beranak 3 kali setiap 2 tahun (selang beranak 8 bulan). Perbedaan terbesar dari tahun ke tahun pada umumnya disebabkan oleh perubahan rataan jumlah anak sekelahiran untuk setiap peternakan (FLS) ($P<0,05$) dan perubahan kematian anak (%M) ($P>0,05$): dari 1,33 dan 20,5% menjadi 1,57 dan 10,4%; masing-masing untuk FLS dan %M antara tahun 1986-87 dan 1987-89. Perubahan ini meningkatkan jumlah anak yang disapih per tahun per induk yang tersedia (LWEA) dari 1,19 pada tahun pertama menjadi 1,60 pada tahun kedua dan ketiga. Perubahan ini diduga karena adanya pengaruh dari penelitian lapang yang dilakukan dengan pendekatan multidisipliner. Peternakan dengan FLS yang cukup besar, meskipun mempunyai mortalitas anak yang tinggi (%M), memberikan kontribusi yang cukup besar terhadap perbaikan LWEA dan total bobot sapih anak. Perbedaan bobot sapih total yang berkisar antara 3,9 - 4,5 kg didapatkan antara FLS dari peternakan dengan peringkat 4 teratas terhadap peringkat 6 terbawah (masing-masing dengan rataan FLS 2,09 dan 1,19). Jumlah anak sekelahiran 2 dan 3 memberikan kontribusi yang sangat besar terhadap produktivitas induk, yakni memberikan bobot sapih total masing-masing 18 dan 23 kg.

Kata kunci: Ruminansia kecil, kinerja reproduksi, peternakan di pedesaan, Jawa Barat

ABSTRACT

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Reproductive performance of small ruminants was evaluated in an on-farm multidisciplinary research project, known as the *outreach pilot project* (OPP), involving village farms in West Java, Indonesia. Strategies to increase production of small ruminants were implemented in this project. Data from three consecutive years (1986-87, 1987-1988 and 1988-1989) showed no significant increase in flock size. Average number of ewes per farm per month (EA) was 4.1. Although on average, larger farms had lower flock performance, a few individual farms with large flocks performed outstandingly in both reproduction and production. Twenty-eight percent of the farms had averaged 10 month lambing intervals (LI) with a potential of 3 lambings every 2 years (8 months interval). Most of the differences between years were mainly due to changes in farm average litter size (FLS) ($P<0.05$) and changes in lamb mortality (%M) ($P>0.05$): from 1.33 and 20.5% to 1.57 and 10.4%; for averages of FLS and %M between years 1986-87 and 1987-89, respectively. These changes were reflected in an increase in the number of lambs weaned per year per ewe available (LWEA) from 1.19 in year 1 to 1.60 in years 2 and 3, and were assumed to be promoted by the on-farm research program. Farms with large FLS in spite of higher %M, contributed a net improvement in LWEA and kilograms of lambs weaned. A different range of 3.9-4.5 kg of lambs weaned was found between the top 4 and the bottom 6 farms for FLS (averaging 2.09 and 1.19, respectively, for FLS). Litter sizes 2 and 3 contributed substantial improvement in ewe productivity, weaning 18 and 23 kg of lambs, respectively.

Key words: Small ruminants, reproductive performance, village farms, West Java

INTRODUCTION

With 6.7 million sheep and 11.5 million goats, Indonesia has the largest population of small ruminants in South East Asia. Usually kept in small flocks by smallholder farmers, sheep and goats are predominantly distributed in the island of Java, with West Java alone accounting for approximately 1/2 of the country's sheep population and 1/6 of the goat population (ANON., 1995). As a component of integrated crop-livestock production systems, small ruminants play a significant role in the economy of many small (average farm size=0.40 ha) and/or landless farmers. Moreover, they represent an alternative source of additional income due to their low initial investment and rearing space requirements, low maintenance costs, year around reproductive potential and prolificacy (KNIPSCHEER *et al.*, 1983).

A typical farm in West Java has a flock size of 4 to 5 animals managed traditionally within the total family farming network (SOEDJANA and KNIPSCHEER, 1982). Animals are mainly fed cut-and-carry forages in the upland regions where very little grazing is possible due to intensive cropping. In the lowland areas, grazing plays a more important role.

Indonesian sheep and goats have the potential to lamb/kid more than once a year, or approximately three times in two years with an important incidence of multiple births (BELL *et al.*, 1983; BRADFORD *et al.*, 1986). Under village conditions, however, this production potential is seriously constrained by economic and management factors which are reflected in low ewe body weights, high preweaning mortalities, low birth weights, long lambing/kidding intervals and the unavailability of rams.

In order to quantify the production constraints on the farmers' flocks and to implement management strategies geared toward the improvement of animal productivity, the Small Ruminant-Collaborative Research Program (SR-CRSP) of the U.S. Agency of International Development and the Research Institute for Animal Production (RIAP) in West Java, started an on-farm research activity known as the Outreach Pilot Project (OPP) in 1984 (GAYLORD, 1985). In the OPP, the production performance of small ruminants raised by a selected group of small scale farmers was monitored monthly.

This paper discusses the reproductive performance of small ruminants, mainly sheep, among the OPP intensive production systems and the response to the research strategies that was implemented for improving reproduction and overall management performance.

MATERIALS AND METHODS

The data for this study were collected from 29 individual OPP farms through a monthly monitoring schedule started in 1984. The monitored animals were mostly Javanese Thin-tail (JTT) sheep. When the OPP was begun in 1984, each farm was given 5 two-year-old or older ewes and 1 two-year-old ram plus the necessary funds to build a small barn. At the end of a five-year period, the farmers would be required to return 10 ewes and 1 ram to the project.

The composition of ewes within flocks consisted mostly of foundation animals and a fraction of animals either born in the flock or acquired from other sources. This condition introduced considerable variation in age to the flocks. Age of animals acquired from other sources was grossly estimated by teeth inspection. The animals were managed by the farmers or family members in an intensive production system, requiring all feed and water to be brought to the small, raised, slatted floor barns at convenient intervals.

Until September 1986, the research activities in the OPP emphasized surveys to define socio-economic baseline profiles (Phase 1). Starting September 1986, the OPP entered into its second phase. At that time the breeding component of the OPP established a baseline inventory and organized detailed monthly production monitoring, after implementing a system of individual animal identification and ram rotations to avoid inbreeding. Parallel to this monitoring, a monthly multidisciplinary research strategy was also implemented to test basic breeding and management practices involving: 1) training farmers in reproductive management practices to improve performance of their flocks, such as maintaining breeding rams in the barns and identification of cycling ewes and, 2) introduction of nutrition and management practices to reduce lamb mortality. The nutrition practices were designed to improve feeding of ewes during the last month of gestation and during lactation. Concurrently, the management practices encouraged the separation of lactating ewes and their lambs by adequate barn divisions. In general, these practices, except salt supplementation, were all affordable by the farmers and only involved utilization of locally available forage products, building materials and family labor.

A total of 270-300 head were monitored monthly in the OPP. performance records discussed in this paper included: flock size, representing the monthly flock size average per farm; ewes available per month per farm (EA) calculated by adding the number of yearling and older ewes present each month over one year and dividing by 12; farm average litter size (FLS); Farm lamb mortality (%M); number of lambs weaned per year per ewe available per farm (LWEA); farm average lambing intervals (FLI); lambing dates; weaning weights (WW) and kg of lamb weaned per ewe lambing (TWW). Data obtained for 3 consecutive years corresponding to phase 2: 1986-1987 (year 1), 1987-1988 (year 2) and 1988-1989 (year 3), which were respectively the 3rd, 4th and 5th year of the OPP, were subjected to analysis with each farm considered as the experimental unit. performance distributions in years 2 and 3 were similar over all farms and traits, thus data from those two years were pooled to contrast with the reference year 1. Basic discussion of the data emphasized results obtained during 1987-89.

Data were analyzed by the Wilcoxon signed-ranks test (CONOVER, 1980) on the basis of comparable pairs of observations. Rank correlations between years and among selected traits were obtained to evaluate potential associative trends.

RESULTS AND DISCUSSION

Lambing distribution

For a total of 358 lambings occurring in years 1, 2 and 3, Figure 1 gives the distribution of lambings per month at the OPP farms. The distribution in Figure 1 departs from a uniform distribution of 1/12 lambings per month ($\chi^2_{(11)}=38.66$, P). Nevertheless, ewes still could be bred any time in the year, but with a higher rate of conception occurring during February-April. The lowest conception rate occurred during the period June-July, corresponding to the dry season.

It is assumed that this fluctuation is directly related to less available forage during the dry season. A similar pattern is found in many tropical breeds of the world (FITZHUGH and BRADFORD, 1983) and in the Sumatran Thin-tailed sheep grazing under rubber trees and under a continuous mating system (INIGUEZ *et al.*, 1991).

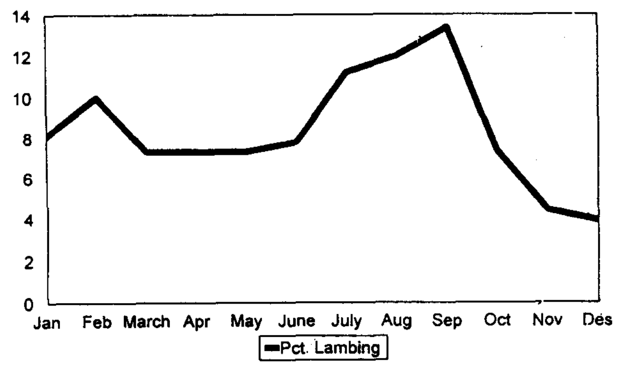

Figure 1. Monthly lambing distribution of Javanese Thin-tailed ewes in the Outreach Pilot Project during 1986-1989

A general summary of the reproduction performance in the OPP farms during the period 1986-89 is shown in Table 1.

Flock size

Two aspects of flock size were considered in this analysis: the overall flock size and the number of ewes available per farm per month.

Overall flock size

Column 1 in Table 1, identifies the same farms in year 1, and years 2 and 3. Nevertheless, it must be pointed out that during the project's development, some farms constituting a group in year 1 became independent farms in later years; for instance, farm 1 in year 1 became farms 1 and 6 in years 2 and 3. This trend resulted in more small flocks in year 2. This may explain a slight (P=0.807) reduction in average flock size from 11.6 (year 1) to 10.6 head (years 2 and 3), (Table 1).

Changes in flock size during years are shown in Table 2 that categorizes farms as small or large, i.e. with less than 10 head or 10 or more head, respectively. Not surprisingly, a higher percentage of small than of large flocks increased in size after the first year.

Ewes available per month per farm (EA)

The number of EA was the closest estimator of flock size with regard to the flock's reproductive potential. Table 3 shows production averages for three categories of farmers during 1987-89: with small flocks (2.2 EA), medium size flocks (3.9 EA), and large flocks (6.2 EA).

Small, medium and large flocks occurred with similar frequencies among the OPP farms. There was not a clear explanation for this variation in size, which was apparently the farmer's decision, since the research program did not emphasize changes in flock size directly. What is important to mention is that 28% of farms departed from the assigned flock size of 4 ewes and were operating with a higher number of (EA 5-8 EA, Table 1). This suggests that research should be directed not only to maximize the production per animal unit but also to explore the alternatives offered by larger flock sizes.

Table 1. Average reproductive performance of small ruminant farms in the Outreach Pilot Project during 1986-1987 (Y_1) and 1987-1988 (Y_{2+3})

Farm[a]	FS		EA		LS		%M		LWEA		LI	
	Y_1	Y_{2+3}	Y_1	Y_{2+3}	Y_1	Y_{2+3}	Y_1	Y_{2+3}	Y_1	Y_{2+3}	Y_1	Y_{2+3}
1	12.2	14.4	4.0	4.2	1.5	2.18	0.0	15.8	1.8	3.45	336	218
2	11.6	9.7	5.0	3.1	1.67	1.39	10.0	5.5	2.4	2.23	297	232
3	14.1	5.0	6.4	1.6	1.33	1.83	0.0	30.0	1.5	1.8	324	206
4	14.6	14.7	5.0	4.2	2.0	1.77	28.6	9.0	2.4	2.51	267	198
5	12.0	15.4	3.5	7.1	1.17	1.59	0.0	11.3	2.4	1.22	330	258
6		10.3		2.6		1.75		16.5		2.26		211
7	5.6	7.5	4.0	2.7	1.0	1.41	0.0	8.5	0.9	1.97	243	228
8		4.7		2.0		1.58		0.0		2.04		168
9	16.2	15.1	5.3	6.5	1.25	1.47	0.0	0.0	1.13	1.82	222	263
10	9.4	19.0	4.4	4.2	1.0	1.65	0.0	0.0	0.5	2.38		273
11	13.1	16.8	3.6	5.5	1.33	1.48	100.0	0.0	0.0	1.7	264	279
12	8.7	11.5	4.0	4.0	1.0	1.4	0.0	7.0	1.2	1.6	276	282
13	17.7	17.6	6.4	7.5	1.0	1.6	28.6	12.5	0.94	1.41	285	258
14	13.4	13.5	4.8	4.5	1.5	1.58	11.1	12.5	2.0	1.86	240	284
15	3.3	7.2	2.0	3.0	2.0	1.5	50.0	8.3	0.6	1.33		351
16		7.7		2.5		1.75		0.0		1.37		239
17	7.2	12.1	5.0	5.2	1.5	1.71	33.3	16.2	0.48	1.45		261
18	10.2	6.0	4.0	2.7	1.0	1.75	0.0	12.5	0.6	1.18	441	284
19		15.0		5.8		2.25		22.5		1.47		319
20	13.2	5.4	5.0	2.2	1.0	1.0	50.0	0.0	0.24	1.39	369	268
21		4.3		1.7		1.25		0.0		1.08		309
22	16.3	15.7	5.0	6.1	1.43	1.55	20.0	6.0	1.92	1.3	267	261
23	8.9	6.8	3.7	3.1	1.75	1.5	57.1	22.5	0.97	1.13	225	301
24		5.6		2.3		1.62		0.0		2.19		329
25	6.3	5.5	1.3	2.4	1.0	1.16	50.0	25.0	0.92	1.19	309	271
26	4.4	4.4	2.0	1.9	1.5	1.0	0.0	0.0	1.80	0.78		365
27	16.7	8.9	5.4	3.5	1.25	1.5	0.0	33.5	1.11	1.01		396
28	12.9	12.2	5.0	4.8	1.0	1.33	0.0	0.0	1.2	0.69	210	256
29	18.0	14.2	7.0	5.9	1.5	2.12	33.3	27.0	0.34	0.74	351	375
Mean	11.6	10.6	4.4	3.9	1.33	1.57	20.5	10.4	1.19	1.60	292	274
CV	36	43	31	43	23	18	127	97	59	37	20	19

[a] farms 1,3,13,18 were owned by a group of farmers in year 1 and became single independent farms in year 2 (farms 1, 6, 3, 8, 21, 13, 19, 16, 18 and 24)

CV : inter-farm coefficients of variation
FS : average flock size
EA : average ewes available per month per farm
FLS : farm average litter size of lambing ewes; %M: average lamb mortality (%)
LWEA : average lamb weaned per EA per year
FLI : farm average lambing interval (days)

The average performance for LWEA was lowest for the large flocks (Table 3). Even though the largest flocks had the greatest FLS, this potential lamb production superiority was more than negated due to ewes in the largest flocks having the longest lambing interval and the highest mortality rate among their lambs. The higher mortality is apparently a reflection of larger flocks tending to have ewes with larger litters (2) which have lower survival rates as the trend of Table 3 suggests. High lamb mortality in larger flocks may also be associated with insufficient barn space or divisions, since the recommendations of the on-farm research were oriented towards smaller flock sizes. No substantial differences were found (P=0.464) in comparing ewes available per month per farm between years (years 1 vs 2 and 3).

Farm average lambing intervals

The on-farm research in the OPP concentrated efforts on reducing the long lambing intervals (12 months), found under village conditions (BELL *et al.*,

Table 2. Changes in flock size from 1986-1987 to 1987-1989 in the Outreach Pilot Project farms

Flock size Category in 1986-1987	n	%	Percent of farms		
			Reducing	Increasing	Unchanged
Large (>10 head)	15	65	60	20	20
Small (<10 head)	8	35	25	62	13

n : number of flocks

1983). The results of Tables 1 and 4 reflect the response to the on-farm research inputs which were directed toward providing breeding rams for mating purposes and to increase the farmers' knowledge of the onset of the estrous cycle. Nevertheless, due to the great variation observed during years with FLI ranging from 210-441 d in year 1 and 168-396 d in years 2 and 3, more efforts should be put forward to bring the level of the poor performing farms up to that of the best.

Provided that breeding rams are available and ewes could be bred at least 2 months after lambing, ewes can produce, on average, 3 lambings every two years with a production 1.5 times the lamb production of farms with FLI=360 d. This production trend was found in the 28% of flocks having 8 month intervals; Tables 1 and 4. Presently our data are not sufficient to determine the farm's consistency with regard to FLI over a period of several years. The FLI distribution of year 1 was practically the same as that of year 2 and 3, (P=0.138).

The increase in lambing intervals in large flocks (Table 3), would suggest that farmers with more animals have less success in attaining a good reproduction rate; however, the degree of association between EA and FLI was low (r=-0.032). Our data set does not

Table 3. Reproduction performance of flocks having different numbers of ewes available per month per farm in the Outreach Pilot Project (1987-1989)

EA		Frequency		Average reproduction performance			
Classes	Class average	n	%	FLS	%M	LWEA	LI (days)
1-2.9	2.2	11	38	1.46[a]	8.4[a]	1.57[a]	262[a]
3-4.9	3.9	10	34	1.58[a]	11.4[a]	1.82[a]	279[a]
≥5	6.2	8	28	1.72[a]	12.0[a]	1.39[a]	284[a]

EA : ewes available per month per farm
n : number of flocks
FLS : farm average litter size
%M : farm average lamb mortality (%)
LWEA : lambs weaned per EA per year
LI : lambing interval (days)
[a] Means within columns bearing similar letters do not differ (P>0.05)

allow us to determine whether this is a consequence of lack of available rams and/or inadequate animal separation as recommended for smaller flocks.

Due to the peculiarities of the experimental units (farms) with a variation in performance as shown in Table 1, the follow-up and study of single farms is apparently an important step in addition to the statistical analysis of the information. The information from years 2 and 3 in Table 1, for instance, allows us to identify outstanding farms for LI (8 months). These are farms 8 and 16 with EA below average and no lamb mortality, contrasting farms 1 and 4 with lower %M and larger EA. Reasons that explain the differences in EA and lamb management among these farms, should be explored further.

Table 4. Distribution of flock lambing interval classes (days) and lamb production performance in the Outreach Pilot Project's farms (1987-1989).

FLI		Frequency		
Classes (days)	Class average (days)	n	%	LWEA
< 240	212	8	28	2.20[a]
241-300	269	13	45	1.48[a]
301-360	322	5	17	1.44[a]
> 360	379	3	10	0.84[b]

FLI : farm average lambing interval
LWEA : average lambs weaned per EA
n : number of flocks
[a] means within columns bearing different letters differ (P<0.05)

Farm average litter size and lamb mortality

High prolificacy is a common characteristic in JTT sheep, (MASON, 1980; BRADFORD *et al.*, 1986), the breed monitored in the OPP. Litter size distribution in the OPP farms, averaging 1.41, SD 0.33 and with CV 22%.

One of the major differences during the analyzed years was due to an increase (P=0.026) in FLS from year 1 to years 2 and 3 (1.33 to 1.57, Table 1) caused by increased frequency of triplets and litters 3 in years 2 and 3 (Table 6). The on-farm research project did not promote raising animals with large litter sizes. However, it provided rams and ewes from the Cicadas Sheep Research Station, where lines of high prolificacy are being developed as a by-product of a test of the hypothesis for a single gene controlling prolificacy in JTT (BRADFORD *et al.*, 1986, TIESNAMURTI, 1988). Since the putative high prolificacy ($FecJ^F$) gene was undoubtedly present in some flocks by chance, there might have been a higher proportion of carrier ewes lambing in years 2 and 3.

High lamb mortality in farms with large FLS, as shown in Table 5, is common in prolific breeds (BRADFORD, 1985) Nevertheless, in spite of a higher mortality rate (23.8%), the lamb crop (LWEA) of flocks with higher mean litter size (1.8) was superior to that of those with smaller litter size, as was total kilograms of lambs weaned. Lamb mortalities for singles twins and triplets (1.67, 15.33 and 30%, respectively, Table 6), were lower than those reported by PURSER and YOUNG (1959), SHELTON (1964) and BRADFORD (1985) for European breeds in temperate climates.

Table 5. Distribution of farm average litter size classes and lamb production per flock in the Outreach Pilot Project's farms (1987-1989)

FLS		Frequency		Average			
Classes	Class average	n	%	%M	LWEA (%)	WW (kg)	TWW (kg)
1-1.39	1.19	6	21	5.1[a]	1.23[a]	10.8	12.3[a]
1.4-1.79	1.59	19	65	9.3[a]	1.67[a]	8.8	12.9[a]
1.8	2.09	4	14	23.8[b]	1.86a	9.8	16.8b

FLS : farm mean liter size
n : number of flocks
%M : lamb mortality (%)
LWEA : lambs weaned per EA per year
WW : lamb weight at weaning (kg)
TWW : kilograms of lambs weaned per lambing ewes (kg)
[a] means within columns bearing different superscripts differ (P<0.05)

On the other hand, the results in the last two columns of Table 5, including the average weight of weaned lambs and kilograms of lambs weaned, show that while lambs born in farms with large FLS were lighter in weaning weight, the total weight of lambs weaned was higher (30-37% higher) than that of farms with smaller FLS, with a net increment of 3.9-4.5 kg.

The individual weaning weights and total weight of lamb weaned, Table 6, show an important contribution of litters 1 to overall productivity. This is reflected in a production change of 40, 80 and 30%, of litters 2, 3 and 3, respectively, relative to the production of singles. These values are substantially higher than those reported for the same breed under experimental conditions (BRADFORD *et al.*, 1991).

The average lamb mortality in years 2 and 3 was substantially lower than that of the first year (10.4 vs 20.5%; P=0.178, Table 1). This reduction in mortality may reasonably be due to practices suggested by the on-farm research team in the OPP: emphasis on feeding the ewes before and during lactation and managing ewes and their lambs separated from the rest of the flock. In inspecting the individual mortality averages per litter size (Table 6), it is clear that the real reduction in mortality was due to the less mortality of twins, the most frequent litter size, in years 2 and 3 (9-12%) compared to that of year 1 (25%).

Table 6. Distribution of individual litter sizes and mortality through the years of observation, average weaning and weight of litter weaned, in the Outreach Pilot Project

Litter Size	Distribution of Litters (%)			Lamb mortality (%)			Weaning weight (kg)	Weight of litter weaned (kg)
	Y_1	Y_2	Y_3	Y_1	Y_2	Y_3		
1	33	33	30	0	2	3	12.8	12.8
2	67	56	57	25	9	12	10.4	18.0
3	-	11	10	-	30	30	9.8	23.0
>3	-	-	3	-	-	51	9.5	16.6

Y_1: 1986-1987
Y_2: 1987-1989
Y_3: 1988-1989

The effect of age did not contribute with significant differences in litter size and lamb mortality.

Changes in lamb mortality and those in farm average litter size, apparently contributed most to the differences observed among years in the OPP farms.

A final comparison of lambs weaned per EA per farm (LWEA) showed a consistent increment (P=0.04) in lamb production in the second period, years 2 and 3, relative to the first year of monitoring, (1.60 vs 1.19). This change was produced by 16 out of 23 farms increasing their lamb production in the second year, (Table 1).

CONCLUSIONS

The statistical analysis of production/reproduction data per se is apparently not sufficient to explain the changes occurring in an on-farm testing environment such as the OPP. Detailed study of production practices of individual farms with performance deviating from the average may provide useful clues to means of changing performance. Closer monitoring of outstanding farmers and the summarization of their management systems, could lead to determining the *most successful* sets of technologies for small ruminant production systems. Application of these sets could produce important production impacts in raising farm productivity. In fact, bringing the poorest 6 farms up to the level of the best 4 for FLS would increase kg weaned by 50%; bringing the poorest 3 farms on lambing interval up to the level of the best group would increase LWEA 150%.

At the end of phase 2 of the OPP, a significant proportion of farms (28%) have flocks above the average of EA (3-4.9 EA); with some flocks performing as well as or better than average flocks which were the best performers both in reproduction (LI) and lamb production (LWEA). This result clearly suggests an investigation of the production consequences of increasing the flock size.

An important impact of the on-farm research was to demonstrate, in 28% of the farms, the feasibility of FLI 8 months with a production potential of 3 lambings every 2 years.

No differences in EA and FLI were found between years. Thus, the increase in FLS and reduction in lamb mortality, in the second period, were the most important effects in raising substantially and consistently the lamb crop (LWEA), from 1.19 to 1.60. Larger flock mean litter sizes (average 2.09) returned more LWEA and kg of lambs weaned at the end of OPP phase 2. In fact, these types of flocks yielded 3.9-4.5 kg of lambs weaned over the production of flocks with smaller FLS (average 1.19-1.59).

Litters of 2 and 3 apparently contributed, at the farmer's level, with substantial improvement in ewe productivity evaluated in terms of total of weight lambs weaned. With an average weaning weight of about 10 kg, ewes lambing twins and triplets weaned 18 and 23 kg of lamb weight, respectively.

The reduction of lambing intervals to intervals below or equal to 8 months and reduction in lamb mortality, with a net increase in lamb productivity, were changes promoted to some extent by the on-farm research program. These efforts consisting of simple husbandry practices, mostly affordable by the farmer, such as: 1) assure ram availability and detection of cycling ewes, 2) improved feeding conditions of ewes and 3) better management of the barns, were also oriented to maximize the family participation and labor availability.

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