Improving Awassi Sheep Productivity by Using Frozen Semen in Jordan, Egypt, and Palestinian Authority

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Table of content

I. Chapter one: Technical and administrative report.

II. Chapter two: Workshops, presentations, farmers participation and knowledge transfer.

Figure legend

List and content of tables

Executive Summary

The laboratory for Artificial Insemination (AI) in sheep and goats is established at the Faculty of Veterinary Medicine at Jordan University of Science and Technology. It is furnished with all needed equipment, instruments, chemicals and established protocols for semen collection, evaluation, freezing and insemination. A line for semen production and dissemination currently is in place. Lambing from several experimental trials using superior-Awassi rams were obtained as shown in the tables and figures in the text. Some of the offspring will be used for breeding this year. The know-how is has been established and transferred to the counterparts in Egypt and the Palestinian Authority (PA) through several workshops, field days and station demonstrations. The know-how supported with the needed theoretical background was also transferred to the national veterinarians and agriculture engineers working in the Ministry of Agriculture, national research centers and academic institutions in Jordan, Egypt and PA. In addition, the technology of AI in sheep was transferred and practiced with the cooperation of Jordanian sheep farmers and results were obtained. Nowadays, more farmers are convinced with AI technology. Furthermore, the AI technology has been incorporated in the curricula to undergraduate and graduate students. On the other hand, limitations regarding the transfer of frozen semen to the PA and Egypt due to political and animal health concerns restricted the transfer of the genetics of those superior rams to Egypt and PA. However, semen from high quality rams in Egypt and P.A can be used for improving the productivity of local sheep breeds as the A.I technology has been transferred and established.

I. INTRODUCTION:

Small ruminants are important for the livelihood of farmers in Jordan. The small ruminants (SR) population is nearly 2.4 million sheep and goats benefiting approximately 40-45 thousand families, which have an average of six members. There is an increasing demand for the products of these animals, mainly milk and meat, by the country's five million people who are concentrated in urban areas (figure1).

The contribution of the agriculture sector (254 million JD, 1JD= $1.4) to the total Gross National Product (GNP) (4,364 million JD) is approximately 5.5%, most of which (58%) derives from animal production. The contribution of animal production to the GNP is 3.19% (General Directorate for Statistic 1997). The contribution of the small ruminant sector to the GNP is not known but is likely to be less than 1%. The total amount of money invested in poultry and livestock amounts to 550 million JD.

Jordan produces approximately 204,622 tons of milk and 14,972 tons of red meat per year. This represents 61.4% and 44% of its needs in milk and red meat, respectively. Sheep produce approximately 23.5% and 56% of the country's total production of milk and meat, respectively, while goats produce approximately 13% the country's milk and 18% of the meat.

Most small ruminant producers are resource – poor farmers with low income and education levels compared with other sectors of the population. Feed costs and the scarcity of feed resources, in addition to other costs such as transportation and water, results in many producers selling part of there flocks in order to be able to feed the remaining animals. The production system include migratory systems managed by Bedouins (20%), semi migratory systems also managed by Bedouins (70%), and intensive or sedentary system (10%). Since 1990's there has been a slight shift from extensive to more intensive or sedentary systems.

Small ruminant populations are decreasing (tables 1and 2). This trend is in contrast to an increasing market demand for their products that is being satisfied by imports. The amount of imported chilled and frozen red meat was 17,183 tons in 1991, increasing to 30,169 tons in 1993.

Milk imports were at 101,957 tons in 1991 and rose to 178,833 tons in 2000. This presents opportunities for production intensification and the insertion of small ruminant producers into the market.

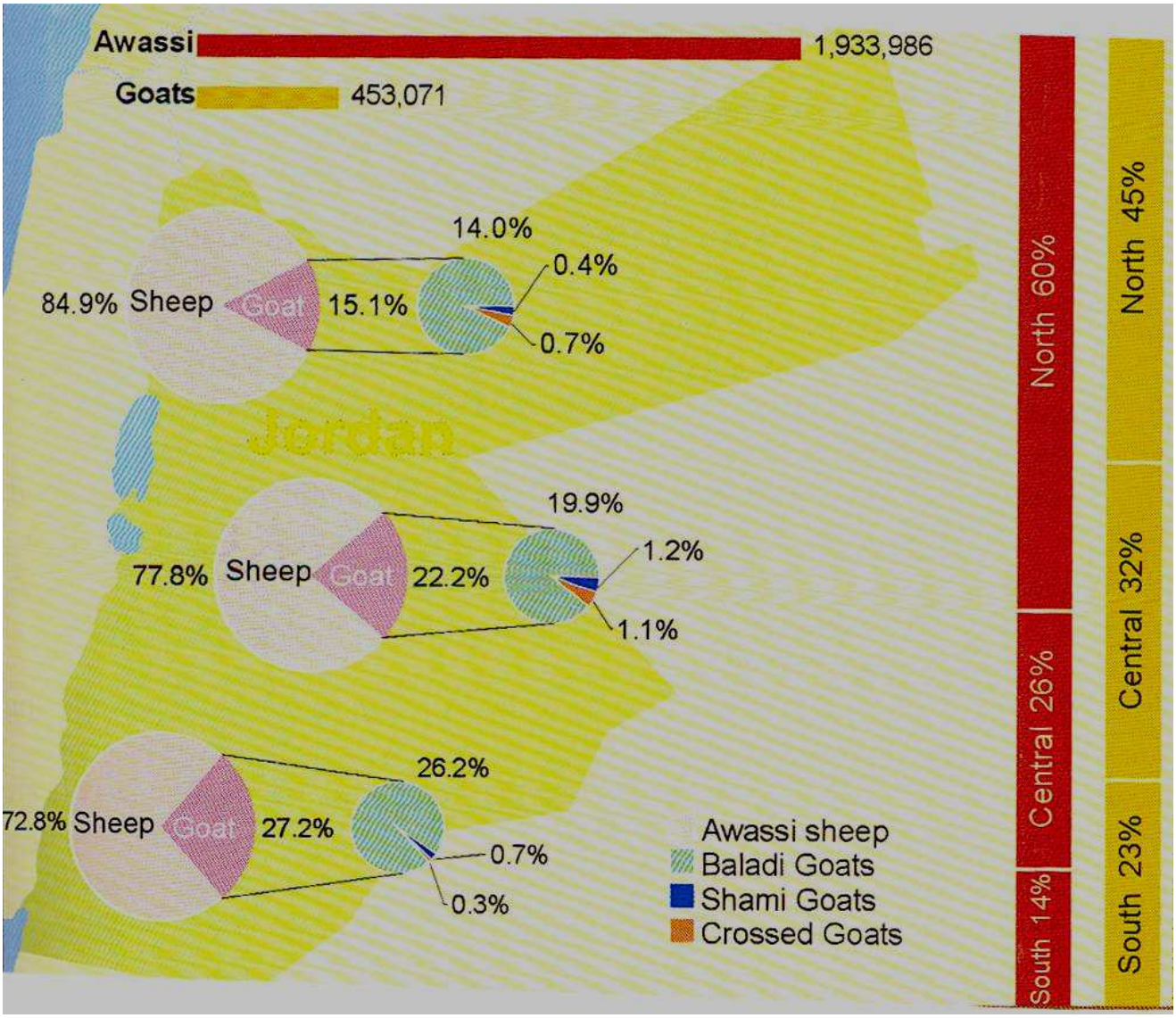
Table 1: Population of small ruminant breeds (/thousand heads) in Jordan and population change in 1991-1999

Species and breed 1991-1999	1991	1995	1997	1999	changes(%)
Awassi sheep	2,671.0	2,375.0	1,935.0	1,933.0	-28
Baladi goats	0,458.0	0,821.0	0,666.0	0,419.0	-9
Shami goats	0,020.6	0,031.0	0,027.0	0,016.0	-2
Crossbred goats	----	0,053.8	0,026.0	0,030.0	NA
Foreign breed goats	----	----	0,001.0	0,000.5	NA
Total goats	0,478.6	0,905.8	0,720.0	0,461.5	-4
Total small ruminants	3,149.6	3,280.8	2,655.0	2,394.5	-24

Table 2: Population of small ruminant (/thousand heads) in Jordan and population change in 2000-2005.

Species	2000	2001	2002	2003	2004	2005
Awassi Sheep	1,895	1,868	1,741	1,793	1,671	2,024
Goats	0,640	0,533	0,729	0,668	0,565	0,555

Figure1: This map shows the population of sheep and goats in Jordan distributed in three regions; north, central, and south of Jordan, also it describes the distribution of sheep and goats according to there breeds. The Awassi sheep breed represents the main sheep breed in Jordan.



II. 1-PROJECT BACKGROUND:

During the last decade, sheep farmers continuously attempted to improve the productivity of their Awassi sheep by selection and mating the superior males and females in their flocks and reducing lamb loss by controlling diseases causing infertility, abortion and neonatal deaths. Unfortunately, this selection was not based on well-documented animal reproduction records or solid knowledge. A regional project aims to genetically improve the Awassi sheep productivity and reducing its related diseases is essential.

This research project is tackling the problem of low productivity of Awassi sheep and gradually improves the low genetic potential of Awassi sheep in the region through the use of frozen and fresh semen obtained from disease free proven sires. The locally produced frozen semen will be distributed to sheep farmers in Jordan, Egypt, and the Palestinian Authority through our cooperation with our counterparts.

1.2- BASIS OF THE PROJECT:

So far most conducted projects in Awassi sheep were directed toward disease prevention and control to reduce the economic losses of sheep farmers associated with these diseases. The use of frozen semen from superior, disease free, proven rams is an essential step for improving animal productivity.

Programme/Project Title:
Improving Awassi Sheep Productivity by using Frozen Semen in Jordan, Egypt and the Palestinian Authority.
Programme/Project Number: INT/01/Ko2/A/95/99
Implementation Agency: General Corporation for Environment Protection/Ministry of the Environment.
Project Starting Date: July 2002. The actual starting date was after April 9th, 2003 (first payment). There was also 10 months delay in the third payment (received January 16th, 2005) which hinders the progress of the project and lengthen the duration.
Project Completion Date: 2004
Total Budget (US$): 110,000
Period Covered By the Report: Final.

III. THE PROJECT DOCUMENT:

1. Project Background:

Sheep in the Middle East are the main animal species raised for milk, meat and wool production. The main breed of sheep is Awassi, which has shown great adaptability to the harsh environmental conditions of the area. Several research works and projects, locally and regionally, have been conducted on disease prevention to increase animal production. There has been a noticeable decrease in the population of sheep and goats during the past 10-15 years (tables 1 & 2). However, most of the sheep population is found in the northern part of Jordan (60%) while the least (14%) is found in the south part of Jordan (table 3).

Little work is done in the improvement of sheep breeds in the area using natural selection and recently fresh diluted semen for AI using local Awassi breeds with little improvement. AI in sheep has given little results. In this project, the objectives were to use superior Awassi rams semen free of diseases for AI of Awassi sheep in Jordan and the PA and Rahmani and the Oseimi breeds, which are similar in characteristics to Awassi sheep, in Egypt using frozen semen.

Table 3: Distribution of small ruminant breeds in Jordan, 1999

Species and breed total,	NORTH		Center		South		
	n	%	n	%	n	%	n
Awassi sheep	1,151,218	60	496,815	26	285,953	14	1,933,986
Baladi goats	189,798	45	126,691	31	102,787	24	419,276
Shami goats	6,055	37	7,414	46	2,564	15	16,033
Crossbred goats	9,172	52	7,296	41	1294	7	17,762
Total goats	205,025	45	141,401	32	106,645	23	453,071
Total small ruminants	1,356,243	57	638,216	27	392,598	16	2,387,057

2. Project objectives:

1. Establish a center for frozen ram semen at the Faculty of Veterinary Medicine at Jordan university of science and Technology.
2. Introduce and breed superior rams at JUST which will be used for semen Collection.
3. Increase capacity building of human resources by training activities, graduate student, and farmers.
4. Shorten the inter-lambing period and increase lambing rate and the litter size.
5. Diagnose and control disease associated with low productivity in Awassi sheep.

3. Project implementation /Institutional framework

The government of Jordan shall execute the project under the UNDP National Execution (NEX) modality. A scientific team at Jordan University of Science and Technology will implement the project and make available on timely basis the progress and financial reports according to UNDP policies and procedure.

IV. Implementation Stages of the Project:

The project was implemented in four stages:

Stage I:

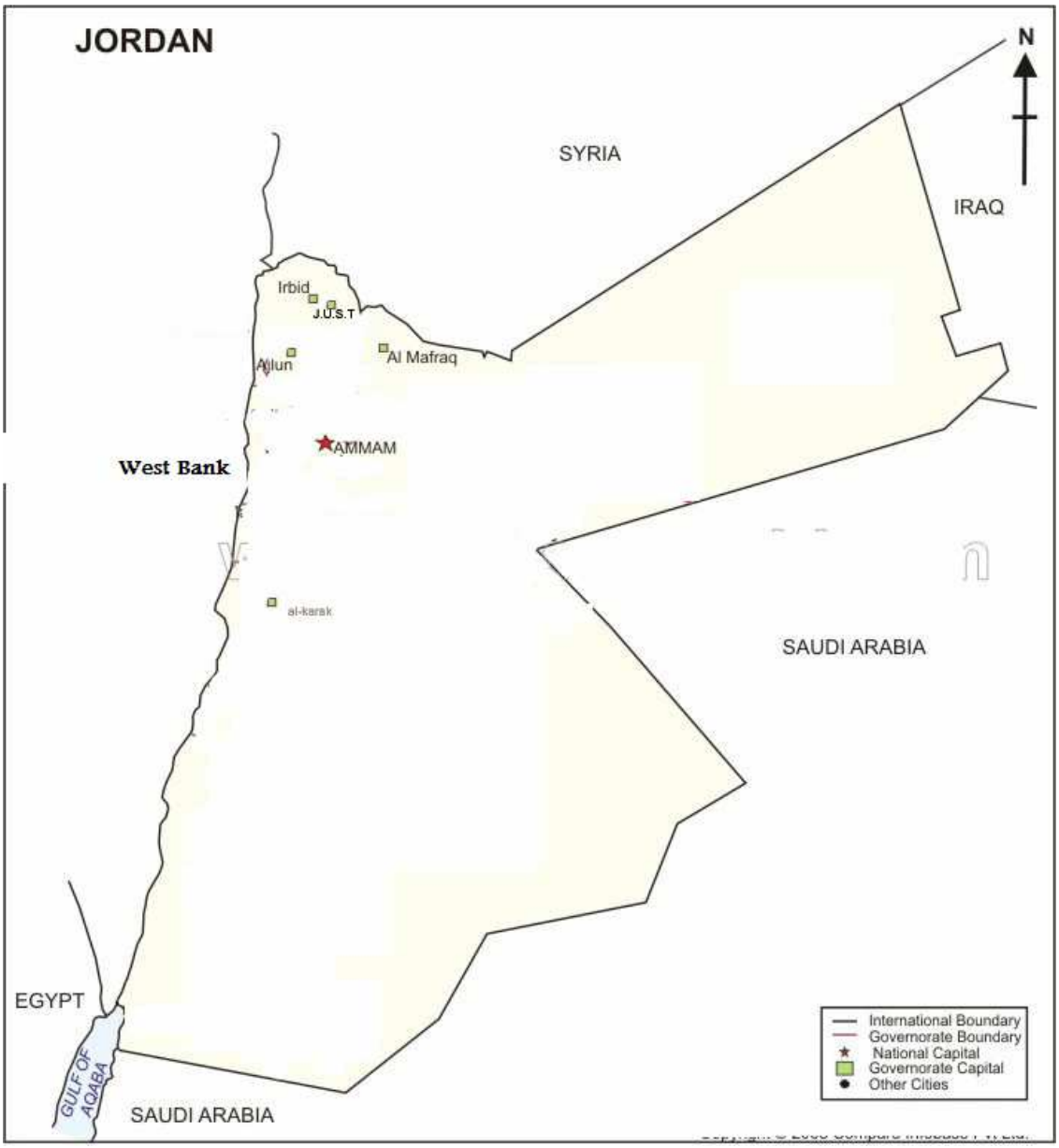
I.A. Purchasing, Preparation and Characterization of the Superior Rams Used in this Study.

Several contacts were made with the Ministry of Agriculture (MoA) in Jordan to purchase the superior and disease-free rams and the contact materialized two months after many failures contacts. After approval from the MoA, Drs. Nabil Hailat and Mohammed Ababneh visited the sheep farm in Al Msharfeh in Al Karak (see figure 2 and 3) where the superior rams are raised. Similar visitations were also made to the sheep farmers under this study in Al-Mafreg, Irbid and Ajloun areas.

We clinically evaluated all the rams in the farm in Al Msharfeh in Al Karak, where rams lambs were selected based on records and clinical examination. The code numbers for these rams are found in the following tables 3-4. The selected rams were purchased and transported to JUST on February 5, 2003. The rams were given prophylactic treatment including antibiotics, multivitamines and minerals and continuous supervision for the first two week of their arrival.

Figure 2: Shows two superior rams(top), which were purchased from the sheep farm of the ministry of agriculture in Al Msharfeh in Al Karak. Notice the high height of the rams with long horns, a body weight of about 110kg, and the fat tail. The large testis suggests the maturity and soundness. The rams are active and healthy, and were kept in the J.U.S.T farm. It shows also an ovarectomized Awassi ewe from J.U.S.T farm (bottom) which was used as a teaser for training rams for semen collection.

Figure 3: This map shows the location of the geographical location of the sheep artificial insemination laboratory at J.U.S.T, the sheep farmers (Mafraq, Irbid, and Ajloun) participated in this project in this study, and the source of the superior rams used for artificial insemination (Karak).



The rams also were subjected for periodical examination and were evaluated for soundness and sexual libido. Several semen samples were collected and evaluated and the results of the soundness and semen analysis are shown in the following tables (3&9). The main genetic characteristics of the five rams such as age, body weight, body weight at birth, body weight at weaning, and dam milk production were collected, and tabulated as shown in the following table 4.

It is observed that the body weight of the superior rams at birth is significantly higher than the body weight of other traditional Awassi sheep in Jordan which ranges between 3.5 to 4.5 kg, while the body weight when the rams are adult is about 70-80kgs at age of three years compared to 110 kg (table 4). It was also reported that weaning weight of traditional Awassi is about 13-14kgs compared to the weaning weight of the superior rams that were used in our study which was found to be 16kg. The milk production of Awassi ewes in the traditional management is about 80-100kg/year which is significantly lower than the dams of the rams used in the study.

Table 4. Some Productive and Genetic Characteristics of the Five Rams Used in the Study

# Ram	Age	Weight (Kg)	Weight at birth (Kg)	Weight at weaning (Kg)	Dam Milk production (Kg/year)
5792	2 years	110	(6.1) Single	16	890
5603	2 years	92	(5.2) Single	16	1043
355	10 months	64	(6) Single	16	960
348	10 months	63	(5.2) Single	15	950
332	10 months	55	(3.5) Cotwin	13	975

When we compared the volume, the sperm count, the consistency, motility, viability, and abnormality of the ejaculates from the super males with mature and sound traditional rams, there was no significant difference. Usually the differences are due to individuals, nutrition, health status, and not to strain variations.

Table .5 Some Results of Semen Analysis of the Superior Rams

Ram#	Volume	Sperm/ml*	Consistency	Motility (%)	Viability (%alive)	Abnormalities
5792	1.2	7.5×10^8	Milky	Fair (60%)	77%	0%
5603	2	1.9×10^9	Thick milky	Fair (65%)	66%	3%
355	1	4.8×10^8	Milky	Good (70%)	80%	2%
348	1.3	8.7×10^8	Thick milky	Good(70%)	76%	1%
332	1.5	1.2×10^9	Thick milky	Good(60%)	77%	3%

I.B. Farmers Questionnaire:

The mating season in sheep and goats in Jordan, in the Palestinian Authority and in Egypt usually is in June, July and in August when the traditional management system is used. However, we found through our surveys and interviews with the farmers, that this induction could vary when vaginal sponges were used for estrous synchronization. Additionally, some sheep farmers have their sheep mate more than once a year if the feeding and the management were optimized (Table 6).

Table 6: Main management characteristics of semi-intensive small ruminant production systems by month as used by the participants.

Main event	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Mating												
Pregnancy												
Lambing												
Lactating												
Milking												
Weaning												
Grazing												
Feeding												
Deworming												
Vaccination												

To study the interest, familiarity and willingness of the sheep farmers to use AI using frozen semen or even fresh diluted semen collected from superior rams, a survey format has been constructed and was conducted on fifty sheep farmers in Al Mafrag and Ajloun areas in Jordan where more than 55% of the small ruminant are raised (Figure 1 and table 7). Similar survey using twelve questioners was conducted in the Palestinian Authority and the collected data was analyzed and results are shown in table 7 and 8. The questionnaire survey was structured and developed to investigate the degree of sheep farmer's awareness regarding the importance of Artificial Insemination (AI) in improving the genetic potential of their animals as well as their desire for the application of the new techniques of Artificial Insemination on their farms.

The questionnaire was completed by fifty of the farm owners selected randomly in Jordan and twelve of the farm owners in the Palestinian Authority. The statistical analyses of this survey is shown in table 7 and 8. It revealed that about 80% of the farms use hormonal sponges to improve conception and twining rates as well as to produce lambs when the demand for lambs meat is maximum during the year. Only 10% of the participated farmers indicated that they use AI in their farms. About 70% of the participated farmers pointed out that their wives carry most of the work in their flock's regarding feeding, milking and grazing. All the participants had the desire to improve the productivity and the genetic potential of their animals by proven sires using natural breeding and only 6% of them by AI. Similar results were noticed regarding their desire to visit the University sheep farm to observe the proven sires and to learn about the advantages resulted from the application of the AI in sheep. It is worthwhile to mention that the level of education of 70% of the participants was less than high school.

Table 7: Results of the structured questionnaire for the 50 Jordanian farmers participated in the regional Artificial Insemination Project in sheep, 2006

Question	**Number**	**%**
Use of hormone sponges		
Yes	**40**	**80**
NO	**10**	**20**
Use of Artificial Insemination		
Yes	**5**	**10**
No	**45**	**90**
Wives participated in sheep farming		
Yes	**35**	**70**
No	**15**	**30**
Desire to use improved Rams on the farm		
Yes	**50**	**100**
No	**0**	**0**
Desire to improving genetic potential by **:**		
AI	**3**	**6**
Natural breeding	**47**	**94**
Desire to visit the University to observe the improved rams		
Yes	**45**	**90**
No	**05**	**10**
Farmer's level of education		
Less than high school	**35**	**70**
High school and more	**15**	**30**

In the PA, the questionnaire was completed by twelve of the farm owners selected randomly. The statistical analyses of this survey are shown in table 8. It revealed that about 80% of the farms use hormonal sponges to improve conception and twining rates as well as to produce lambs when the demand for lambs meat is maximum during the year. Only 8% of the participated farmers indicated that they use AI in their farms. About 67% of the participated farmers pointed out that their wives carry most of the work in their flock's regarding feeding, milking and grazing. All the participants had the desire to improve the productivity and the genetic potential of their animals by proven sires using natural breeding and only 8% of them by AI. Similar results were noticed regarding their desire to visit the University sheep farm to observe the proven sires and to learn about the advantages resulted from the application of the AI in sheep. It is worthwhile to mention that the level of education of 67% of participant was less than high school. When the results of the questioners from the PA was compared with those from Jordan, it was found that no difference between the parameters studied, strongly suggesting similar managemental conditions.

Table 8: Results of the structured questionnaire for the 12 Palestinian farmers participated in the regional Artificial Insemination Project in sheep, 2006

Question	Number	%
Use of hormone sponges		
Yes	**10**	**80.3**
NO	**02**	**19.7**
Use of Artificial Insemination		
Yes	**1**	**8.3**
No	**11**	**91.7**
Wives participated in sheep farming		
Yes	**8**	**67**
No	**4**	**33**
Desire to use improved Rams on the farm		
Yes	**50**	**100**
No	**0**	**0**
Desire to improving genetic potential by **:**		
AI	**1**	**8.3**
Natural breeding	**11**	**91.7**
Desire to visit the University to observe the improved rams		
Yes	**12**	**100**
No	**0**	**0**
Farmer's level of education		
Less than high school	**8**	**67**
High school and more	**4**	**33**

I.C. Meeting at Assiut University, Egypt, 13-14, April, 2003.

Contact with the Dean of Veterinary Medicine at Assiut University was made to organize a meeting for all parties concerned to discuss all the phases of the projects. Both Drs. Nabil Hailat and Mohammed Ababneh visited Assiut university on 13 and 14 of April, 2003 for two days to discuss the projects and its phases. The PA team was invited to attend the meeting. However, they were unable to join the meeting for some administrative and political problems.

During the visit to AU, we have several meetings with the department head Dr. Ahmad Abdelrahman, a specialist in Theriogenology and with one of his staff who is specialist in AI. In Assiut University, we visited the faculty sheep farm where we saw the local sheep breeds which they were assigned to be used in this project, the Ossimi. We also visited another sheep farm which is about 20 Km a way from AU in AL Azhar university at the faculty of Agriculture where we met Dr.Salem Ibrahim the responsible person of the Rahmani flock.

The Rahmani breed milk production is about 0.5 kg/day, the twinning rate is 1.2, the weight at birth is 3 kg and the weaning weight is 18-20 kg at 3 months. The amount of wool produced per head per year is 2.7 kg and sheared twice a year. The Oseimi breed produce about 0.5 kg of milk per day, the twining rate is 1.2 and the weight at birth is 4 kg and the weaning weight is 15-16kg at 2.5-3 months. The colour of Oseim is similar to the Awassi in Jordan while the color of the Rahamani is more to the brown. Both breeds are fat tailed breeds with small spiral tail in the end of the fat tail. Discussions were carried out regarding the productive and reproductive characteristics of the two breeds and how the Awassi superior Rams may improve their productivity. Agreement was made with the team in AU to come to Jordan for training on AI in sheep which was accomplished later. An invitation was extended to our counterpart in the PA, Dr. Hatem Attalah, to participate in the workshop.

I.D. Problems facing sheep farmers according to the survey and personal interviews in Mafraq, and Ajloun areas

During the course of filling the questioner by the farmers and of the personal interviews, the farmers reported that the major problems that fac livestock industry in Jordan (specially sheep and goats) are:

1) Low productivity of animals in regards to meat and milk production and they where requesting for better quality of animal breeds and improved managemental programs.
2) The scarcity and the high cost of animal feed.
3) Animal vaccines and medications.
4) Abortions.
5) Neonatal disease and mortality.
6) Emaciation and weight loss.
7) Pica.
8) Transboundary animal diseases through the northern borders of Jordan.

These problems where seriously considered by our team when we organized and executed the workshops, and some solutions and instructions where provided to farmers. From our previous experience in Ajloun and Al-Mowagar (north of Amman) areas, where two workshops conducted before and during the course of this project, we found the farmers, who participated and accepted the information that we give them, and the knowledge transfer we made, had better results and minimal losses in regard to abortions and neonatal deaths.

Stage II:

II.A. Special Workshop for the Counterparts:

Contacts were made with our counterparts; **Drs. Ahmad Abdel Razag and Abdel Razag Khalefeh** from Assiut University /Egypt and **Dr. Hatem Attalah** from Al Najah University from the PA and an invitation was extended to participate in the workshop which was held at our university on August 9-12, 2003. A two days wet labs were organized by the supervision of Dr. Ababneh. The first day was demonstration and hands on ultrasonography and trans-cervical AI in experimental animals at JUST. The second day was field day where 20 ewes owned by one of the farmers participants of the project in al-Mafreg were artificially inseminated using frozen semen.

II.B Training An Agri. Engineer and graduate student for AI:

To secure a good progress in the project we hired Agri.Eng. Hassan Al-Gozlan for six months starting June, 2003 to take care of the superior rams, collect and freeze semen, and participate in the insemination process. Two graduate students were trained how to collect, prepare, freeze, though, and use semen for artificial insemination in sheep. The technique was also presented to the undergraduate `4th and 5th year students during the teaching course of Theriogenology.

II.C Freezing Procedure of Ram Semen:

The following procedures have been practiced :

1- Preparation of the 5 rams to be collected.
2- Preparation and testing Ram semen extender
3- Semen was collected and frozen.
4- Frozen semen was evaluated post thaw.
5- Frozen and fresh semen was used to inseminate 90 ewes in 8 flocks.

Five to six semen collections were made from the rams with an average of 1.6ml of ejaculate, and they were frozen (Table 9 and figure4). The dilution rate was 1:4 and the average initial gross motility ranged between 60 and 80%. The post thawing motility was between 35 – 50%. The average number of straws was 9 and the total frozen straws from four rams was 209.

Table 9: Summary of the Freezing Procedure of Ram Semen

Ram	No. collections	Average Volume	Dilution Rate	Average Initial Gross Motility	Post-Thaw Motility	Freezing Method	Average No. of Straws	Total frozen straws
5792	5	1.2	1:4	60%	35-40%	Cold	7	35
348	6	1.7	1:4	80%	>50%	Cold	10	60
*5603	2	2	–	<30%	–	–	–	–
332	6	1.6	1:4	75%	35-40%	Cold	9	54
355	5	1.7	1:4	80%	40-50%	Cold	10	60

*Semen form this ram was not frozen due to low gross motility and bad quality of semen.

Figure 4: Semen collection using electroejaculator during a training workshop for national veterinarians and agriculture engineers at JUST.

The number of sheep flocks used in this study was 8. The size of the flock ranged between 20 and 300 heads. There was a variation in the number of ewes inseminated per flock, which is independent of the flock size. The penetration rate range between 75% and 100%. The pregnancy rate (non returned rate) was 60-70% in seven flocks out of eight. And only one flock had 50% pregnancy rate. The pregnancy rate using ultra sound exam was between 25-50% in three flocks, while 10% in the rest.

Table 10: Summary of insemination procedures:

Owner name and place	No. of Ewes inseminated/Flock Size	Penetration rate	Pregnancy rate (Non return rate)	Pregnancy rate (Ultrasound exam)
Mohmmaed hassan Mqbel/ Aldajaneeh /Mafraq	4/20	75%	50%	25%
Salem Sliman Hijazi/ Aldajaneeh /Mafraq	6/25	80%	66%	50%
Hasan Al-Omari / Dair-Yousef, Irbid	10/300	90%	70%	50%
Yousef Um-El-Na'am, Mafraq	10/300	90%	60%	10%
Mohammed Saleh Shidifate; Almancheeh / Mefraq	25/240	100%	64%	10%
Ahmed Obiadate Herta/ Irbid	5/30	80%	60%	10%
Omar hasan Irshiad Almancheeh / Mefraq	20/300	100%	65%	10%
Mohammed Obiadate Herta/ Irbid	10/80	100%	70%	10%

Figure 5: Awassi ewe in the cradle ready for artificial insemination.

Stage III:

III.A Contacts were made with our counterparts; Drs.Ahmad Abdel Razag and Abdel Razag Khalefeh from Assiut University /Egypt and Dr. Hatem Attalah from Al Nagah University from the PA and an invitation was extended to participate in the workshop which we organized at our university on August 9-12, 2004. Semen collection and practical training on Awassi females was conducted. Field visits to several sheep farms was also conducted to share with the participants information related to sheep husbandry in Jordan.

A request from the Dean of the faculty of Veterinary Medicine was sent to me to provide them with hormones (vaginal sponges, PMSG hormones etc) and some needed instrument and materials. This was put forward for tendering the requested materials and once the materials are received we transported them to the PA. Some of the problems that we were facing with our counterparts in Egypt were the entry of the frozen semen to Egypt. Contacts were made with veterinary officer in Egypt to facilitate the process of transport and entry frozen Awassi Ram semen from Jordan. However, due to health issues for disease control, semen from the superior rams were not exported to Egypt.

III.B The artificial insemination lab is currently well furnished with major equipments and instruments necessary for semen collection, processing and freezing. In addition, Computer Assister Semen-motility Analyzer (CASA) was delivered to the lab. CASA has been used to improve the control measures in semen evaluation procedures, and supports all research in the area of freezing ram semen, which will help in national and regional distribution of improved Awassi ram semen.

Equipments in the lab include centrifuge, osmometer, and microscope with heating stage, incubator, refrigerator, cooling cabinet, pH meter, vortex, hot plates, spectrophotometer, and water distillation unit, which are all shown below(Fig 6).

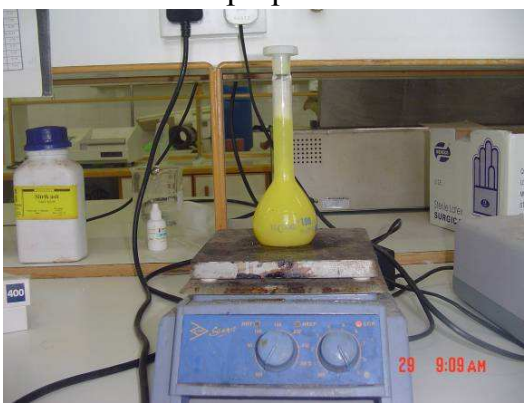
Figure 6: Shows process of semen collection, evaluation, and insemination, images (1-14)

Electroejaculator

stage warmer for slides

Balance

diluents preparation



Hoof trimming cradle

placing the sheep for A.I

Inserting the speculum

Searching for the cervix

Pulling the cervix

Alternative technique: vaginal insemination with fresh semen

The A.I laboratory is also furnished with special instruments including artificial insemination kit (figure 7), which consists of the following and shown below:

A. Speculum.
B. Bozeman forceps.
C. Stem light for sheep AI
D. Transcervical AI gun.
E. Transcervical needles adapted for use with gun.

Due to unavailability of the T-AI kit commercially, the kit was manufactured locally at JUST workshops with the following modification which was distributed to the Palestinian Authority and university of Assuit – Egypt:

a. Speculum: the top part was modified to a flare-up end speculum as in the following figure for easier manipulation of the Bozeman forceps.

b. T-AI gun: the gun was modified to fit the post-load of semen procedure rather than pre-load one. This will ensure higher post-thaw quality of loaded semen by reducing the interval between semen thawing and deposition.

Figure 7: Modified Artificial insemination Kit. Note the flare up end of the speculum to facilitate manipulation of the Forceps (long arrow). The insemination gun (short arrow) was modified for post cervical penetration loading.

Other instruments and devices include electro-ejaculator, artificial vagina, semen freezing tools, liquid nitrogen storage tanks, balance, and a dry vapor shipper for safe air-shipment of the semen were purchased to the laboratory. In addition, the lab was equipped with various glassware and chemicals necessary for preparation of various semen handling, evaluation, and freezing media.

The following procedures have been practiced during the few last months:
Ram semen was collected and frozen. Post-thaw evaluation of semen was carried out after each freezing trial.
Because of being outside the season for insemination, the work in the project focused on ram semen collection and storage with no inseminations being made. However, previous inseminations were followed up. Semen collected during the last period was kept for insemination during the following breeding season.

Lambs from the previous inseminations were born during the last six months, those, first generation, lambs will be followed up to assure their superior genetic potentials for the main production traits.

Six to eight semen collections were made from the rams with an average of 1.2ml of ejaculate, and they were frozen (table 11). The dilution rate was 1:4 and the average initial gross motility ranged between 65 and 80%. The post thawing motility was between 40 – 55%. The average number of straws was 6.2 and the total frozen straws from four rams was 262.

Table 11: Summary of the freezing procedures of ram semen:

Ram	No. Collections	Average volume (ml)	Dilution rate	Average initial gross motility	Average Post-thaw motility	Freezing method	Average number of straws	Total frozen straws
5792	8	1.1	1:4	65%	40%	Cold	8	64
348	8	1.6	1:4	80%	55%	Cold	10	80
332	6	1.5	1:4	80%	40%	Cold	8	48
355	7	1.2	1:4	75%	45%	Cold	10	70

* The ram tagged 5603 was shown to have consequent low gross motility at collection via artificial vagina and electro-ejaculator. Thus, this ram was excluded from further collections and removed from the project.
Additional freezing trails were taking place to increase the number of straws and ram semen bank.

Stage IV:

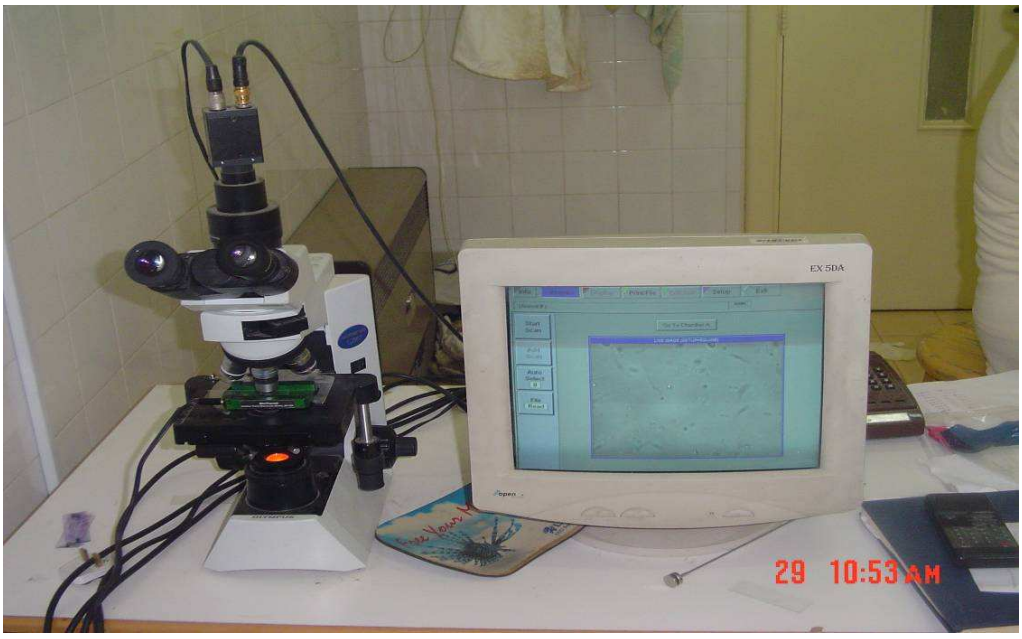
The artificial insemination lab was well furnished with major equipments and instruments necessary for semen collection, processing and freezing. In addition, Computer Assister Semen-motility Analyzer (CASA) has been delivered to the lab. Program included in the CASA package for sheep semen was modified to accurately analyze Awassi ram semen. The following procedures have been practiced: Ram semen was collected and frozen, and Post-thaw evaluation of semen was carried out after each freezing trial using CASA.

Table 12: Summary of the freezing procedures of ram semen:

Ram*	No. Collections	Average volume (ml)	Average initial gross motility	Average Post-thaw motility	Freezing method	Average number of straws	Total frozen straws
5792	3	1.1	65%	40%	Cold	8	20
348	2	1.6	80%	55%	Cold	10	15
332	3	1.5	80%	40%	Cold	8	19
355	2	1.2	75%	45%	Cold	10	15

The dilution rate was 1:4. Three rams were sold and two new pure bred improved Awassi were purchased to avoid inbreeding and increase genetic diversity between the progeny of these rams.

Figure 8: shows Computer Assister Semen-motility Analyzer (CASA) where semen is being analyzed and evaluated.



A new set of experiment was initiated using 50 pluriparous Awassi ewes in the northern part of Irbid which were synchronized for estrus. They were inseminated using frozen semen on 22-24 of July 2005. Transcervical penetration was successful in 42 ewes (84%). Out of those, 19 ewes (45%) were diagnosed pregnant by ultrasonography two months after insemination. Twelve ewes (28%) lambed within 148 days of insemination. Except for 3 ewes with twins and one ewe with triplets, all ewes (8) had single lamb. The prolificacy rate was 1.4 lamb./ewe.

Figure 9: Shows two lambs, the small one is from a dam and a ram of traditional Awassi sheep, while the large lamb in the top is from superior ram used in our experiment using frozen semen. These two lambs are at weaning age. Below is another lamb at weaning,

Figure 10: Ewe-lamb post-weaning. The ewe-lamb was the result of superior rams using frozen semen with a traditional Awassi sheep.

Figure 11: A male offspring of the superior rams using frozen semen. Notice the body shape,rams height and the length from the fat tail to the head which is longer than the traditional Awassi of the same age and sex.

Figure 12: A 14- month old female from superior ram used in our study using frozen semen technique. Notice the body length from tail to the head, and the height of the animal. Both height and length are larger than traditional Awassi sheep of same age and sex. Notice also smaller size of the fatty tail.

Figure 13: A young ram, an offspring of a superior ram and a traditional Awassi ewe using frozen semen. Notice the length of its body from the tail to the head, and the height which is again larger than there counterpart in the traditional Awassi sheep. It is very obvious from the picture that the fat tail is smaller than its counterpart in the traditional Awassi sheep. This ram will be used to produce F2.The following figure shows the two animals for comparison.

Figure 14: shows the fat tails of two animals; the left one is a traditional Awassi ewe, while the right one is from the superior Awassi ram using frozen semen. The tail of the right animal is smaller than the left one and does not cover both legs while the left fat tail covers both legs and looks heavier. This may facilitate the mating between the rams and the ewes as the ram has to elevate the fat tail to breed the ewes.

Figure 15: it shows two ewes the front one is a Traditional Awassi sheep, while the second one in the photo is from superior ram using frozen semen. Notice the height of the back one which is higher and the body is slightly longer.

Figure 16: Two heads of sheep; the left one is from superior ram using frozen semen, while the right one with the horns is a traditional Awassi sheep. Notice the head of left one is higher than the right one.

Figure 17: A flock of sheep and goats. The first ewe in the front of the picture with a brown head and neck, and the young ram at the end of the pictures an offspring of superior ram using frozen semen and traditional Awassi sheep. Notice the body contour.

The A.I technology has been established in the university and the center for artificial insemination in sheep is well equipped. Several undergraduate students were trained using A.I technology in the A.I Lab. In addition three master students were trained in this technology; and two veterinarians and an agriculture engineer. The agriculture engineer has been appointed permanently in the faculty of agriculture in J.U.S.T. One of the graduate veterinarian students who graduated has conducted field experiment using imported rams (Assaf and Mekhla'i rams) for artificial insemination. Thirty ewes were inseminated under our supervision using fresh diluted semen from those rams, and the results are pending. We also conducted two more experiments using fresh diluted semen from imported rams (breed selected for milk, Assaf and Mekhla'i rams) upon the request of the sheep farmers who elected to use their semen instead semen from our superior rams. Two flocks of sheep were inseminated and 29/30 and 27/30 were diagnosed pregnant using ultrasonography. However one flock was infected with sheep pox, and only 12/30 lambed. Fifteen ewes had pregnancy failure as a result of fever and pox infection. The other flock is near lambing. Below are some pictures of the offsprings obtained in these experiments.

Figure 18: Shows an improved Assaf ram from a local sheep farm in AL-Mafraq area. Used for artificial insemination using fresh diluted semen.

Figure 19: Shows offspring lamb from a locally improved Awassi ram from Al-Mafraq sheep farm, using fresh diluted semen, the offspring is nursing its mother.

Figure 20: Shows two offspring lambs from imported Assaf ram from Al-Mafraq sheep farm, using fresh diluted semen.

Stage V:

Future work and recommendations:

1- To support and maintain the AI center at JUST and use it as a center for excellence for training and educational programs on AI, regionally and internationally.
2- The current AI center is an excellent platform for future advances and opportunities for small ruminants biotechnology outreach which can improves the livelihood of sheep and goats farmers and alleviate poverty.

3- To increase the awareness of small ruminants farmers in Jordan about the importance of using genetically superior rams to increase the productivity of the sheep flocks, and to disseminate the farmers experience to other countries in the region.

4- To increase the awareness of veterinarians and agriculture scientists in Jordan about the importance of using genetically superior rams and the importance of the prevention of the reproductive diseases for the purpose of increasing the productivity of the sheep flocks.

5- To conduct long term studies to record and file the reproductive performance of the offspring of the superior rams.