

**Final Project Report  
Research in Alternative Livelihoods Fund (RALF)  
(Project Number: RALF01-11)**

**Improved Rural Incomes from Better Forage Production and Sales of Milk Products**

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## 1. Background and project summary

An estimated 20 – 30% of rural Afghans are dependent on opium poppies, either by growing it or as laborers who tend and harvest the crop. The poppy industry is rapidly expanding in Baghlan Province in north-west Afghanistan. Alternative livelihoods to poppy growing are, therefore, urgently needed to slow the spread of poppies to new areas in the province.

The province also has a high potential for livestock production and marketing of livestock products. Most households have some arable land and many of them own a cow or two. Milk produced mainly by cows is consumed fresh or as milk products and the surplus is bartered for other goods or sold to traders. Thus, market-oriented smallholder dairy production could be an alternative livelihood to poppy growing. To make more milk and milk products available for marketing, however, the feeding, health care and management of the livestock, and milk processing need to be improved. Better feeding could be achieved by improving the supply of quality forage from better varieties and cultural practices. Higher outputs and sales of milk products from well-fed and healthy cows could improve household food security and income.

The overall objective of the project was to promote smallholder dairy as an alternative livelihoods to poppy growing to increase household income and food security. Specific objectives were to:

1. Identify constraints and opportunities for smallholder dairy production as an alternative livelihood to poppy growing.
2. Test and promote with farmers best practices for fodder production, dairy cattle feeding, and milk processing.
3. Strengthen capacity of partners for fodder and dairy production research-for-development through knowledge exchange and training.

The target was to reach out to 75 households in five communities in Baghlan Province, north-west Afghanistan. The main stakeholder groups were: farming households in the communities, share-croppers who are often the most vulnerable social groups since they are locked into poppy production because of their indebtedness, women and school children who are exploited as unpaid labor to tend to the poppy crops, users of opium or heroin in Afghanistan, local entrepreneurs, officials in the local and international NGOs, staff of Afghan ministries of agriculture and universities.

Table 1 presents a summary of the project. Community-based, participatory approaches were used to ensure full involvement of all the stakeholders in the target communities. This report presents activities implemented under each output, results and achievements for each activity, and outlines the implications of research findings and achievements on livelihoods. It stresses on participation and involvement of collaborators, target institutions and farmers with emphasis on gender.

Table 1  
Project summary

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<b>1. Project Title</b>	Improved rural incomes from better forage production and sales of milk products
<b>2. Period</b>	Start: 1 June 2004    Finish: 30 June 2008
<b>3. Target areas</b>	Poppy growing areas in Baghlan Province, Afghanistan.
<b>4. Principal investigator</b>	Asamoah Larbi (a.larbi@cgiar.org), ICARDA, Aleppo, Syria
<b>5. Lead institution</b>	International Center for Agricultural Research in the Dry Areas
<b>6. Collaborators institute</b>	Ministry of Agriculture, Irrigation and Livestock (MAIL), Kabul, Afghanistan. Aga Khan Foundation (AKF), Kabul, Afghanistan. The Macaulay Institute, United Kingdom.
<b>7. Goal</b>	Sustainable and profitable alternative livelihoods for livestock-owning households and other rural stakeholders in areas of Afghanistan where poppies are grown.
<b>8. Purpose</b>	Promote more efficient use of rainfed and irrigated arable land for the sustainable production of forage crops for livestock, which result in better animal health and higher outputs of milk and milk products, thereby reducing household vulnerability through the sale of more milk products
<b>9. Expected outputs</b>	1. Multiple partners and communities selected. 2. Best practices to improve fodder production. 3. Feeding packages to increase milk yield. 4. Efficient milk processing methods. 5. Strengthened capacity and improved knowledge. 6. An assessment of technology impact on livelihoods.

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## **2. Implemented work program**

### **Output 1: Partners and communities selected**

#### **1.1. Introduction**

In the search for alternative livelihoods to poppy growing, selection of appropriate communities, and the use of participatory approaches to establish effective partnerships to analyze livelihoods strategies to identify key constraints and opportunities is important. Major actors include: community-based organizations, national and international research and development agencies, local and international non-governmental (NGOs), farmers' interest groups, share-croppers, women and school children who are exploited as unpaid labor to tend to the poppy crops, and local entrepreneurs. This section outlines activities implemented to select representative communities and households to collect baseline data on livelihood strategies, and market for milk and dairy products.

#### **1.2 Activities implemented**

##### **Activity 1. Selection of communities and households**

###### 1.1 Procedures

Two stakeholder consultations were held in Kabul in September 2004 and Baghlan in December 2004 to select districts and communities for the project. The project leader (A Labia) and then ICARDA-Afghanistan Country Manager (N Wassim) represented ICARDA at the Kabul meeting. MAIL was represented by the General Directors of Veterinary Services and Animal Production, and AKF by the National Participatory and Diversification Advisor (R Rameh), Rural Development Director (H Sutter), Natural Resources Management Advisor (M I Siddiqui), and the Regional Rural Development Coordinator (M Sachin Sachdeva). At the meeting in Baghlan, MAIL was represented by the Baghlan Province Directors of Agriculture, Extension and Research. AKF was represented by the National Participatory and Diversification Advisor, and ICARDA by the RALF Program Manager (N Malik), A Larbi, and Deputy ICARDA-Afghanistan Country Manager (A Manan). Representatives of the farming communities were present.

Criteria used in selecting the communities included: 1) representative of the biophysical and socio-economic spectrum in the target areas, 2) both rainfed and irrigated farming are practices, forage crop are grown and fallow-land is available and accessible to grow forage crops, 3) livestock are important source of household income, 4) farmer who are willing to participate in the project have land, livestock, labor and other resources needed for applied research, 5) the communities are accessible to by vehicle for much of the year, 6) opium

poppies are grown in the area, and 7) presence of other development projects or partners – e.g. communities where AKF was working.

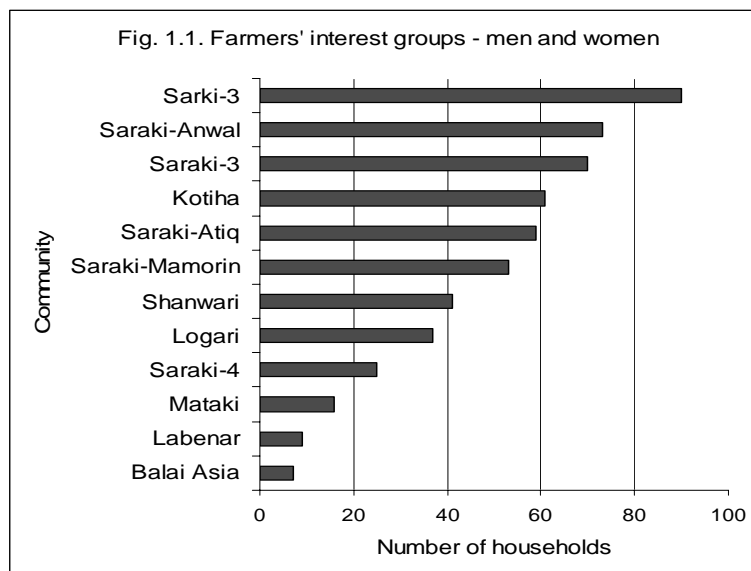
## 1.2 Results and achievements

Based on the consultations and field visits, communities selected for the implementation of the project included Bebe-Ghahwara, Balai-Asia, Dan-e-Wakhshak, Kothia Labenar, Logari, Matak, Nilan, Qeshlak-e-Baikh, Saraki-2, Saraki-3, Saraki-4, Saraki-Anwal, Saraki-Atiq, Saraki-Mamorin, Shanwari, and Tapa-e-Sangank.

Communities were encouraged to form farmers' interest group. Four women were employed as project staff to facilitate the involvement of women and establishment of women's groups. By April 2008, associations of livestock farmers made up of women and men from 600 households had been formed in 13 villages (Fig. 1.1). The associations were used as avenues to promote good practices in smallholder fodder and dairy production as a means to improve household food security and incomes.

## 1.3 Conclusions

Six hundred households in 13 communities participated in the implementation of the project activities. This is far higher than 75 households in five communities in the original project document, meaning that the project exceeded its original target by eight-fold.



## **Activity 2. Participatory workshops to collect baseline data**

### 2.1 Procedures

Participatory workshops were held in selected communities to select household, define the importance of livestock in household livelihood strategies, local vulnerabilities and priorities. Rapid participatory appraisals using group discussions and farm visits were used to collect baseline data which included information on: livestock production systems, women's roles in livestock production, processing and marketing of livestock products, feed resources and feeding systems, current forage production and harvesting practices. Constraints to forage production, dairy cattle feeding, and the production, processing and marketing of milk were documented. The project components and activities were discussed and revised.

### 2.1 Results and achievements

#### *2.1.1 Livestock production system*

Majority of the farmers in the selected communities were crop-livestock farmers. Main crops were wheat, flax, melon, maize and cotton. Livestock consisted of cattle, oxen, sheep, goats, donkeys and chicken. Cattle, sheep and goats raised in two systems. The nomadic or rangeland-based and the sedentary crop-livestock systems. The cattle breeds are mainly local Kandary and Sistani breeds and their crosses with Friesians. Most of the cattle are found in the crop-livestock systems where they are kept for milk, land cultivation, dung, and fuel by Afghan farmers. The small ruminants are mostly found in the nomadic system. Cattle are preferred to goats because they do not require labor for herding, and are used to cultivate land for crop production. Sale of livestock and livestock products contribute about 20-40% of the annual household income. The milking cow is the most preferred because it produces milk for home consumption and for sale. Health care is minimal. Few farmers vaccinate their animals against infectious diseases. Limited numbers deworm to control endo-parasites and spraying to control ecto-parasites is rarely practiced.

#### *2.1.2 Feeds and feeding*

The main feed resources are grassland grazing, cereal straw (barley, wheat), haulms of grain legumes (mung-bean), forage legumes fed either

green or dried, and agro-industrial by products such as cotton and flax seed cakes. Both grazing and hand-feeding are practiced. Farmers graze their animals both in winter and summer. The winter grazing season is from September-October, and the grazing periods are 0700-1000 hours in the morning, and from 1300–1600 hours in the afternoon. The summer grazing season is from February-June, with grazing periods of 0500 – 0900 hours in the morning, and from 1500-1800 hours in the afternoon.

Minimum supplementation is practiced. Grazing cows and calves are supplemented with household waste such as bread, cotton seed cake (CSC), flax seed cake (FSC) and wheat bran. During winter, cattle are kept indoors and fed a basal diet consisting of mostly wheat straw supplemented with nitrogen-rich oil-seed cakes (CSC and FSC), berseem and alfalfa hay, and food legume haulms e.g. mung-bean. In spring and summer, fresh fodder mostly alfalfa and berseem are used as supplements to grazing animals.

The protein supplements are normally mixed with the wheat straw before feeding. Most farmers in the target area preferred CSC in summer and FSC in winter because they claim the FSC keeps their animals warmer than CSC. Farmers preferred berseem hay to alfalfa hay because cows eat more of berseem hay, and also alfalfa hay tends to have more stems than berseem hay.

### 2.2.3 Forage production

Most farmers grow rainfed or irrigated fodder to feed their animals or for sale to generate income. Alfalfa (*Medicago sativa*) is the most widely grown fodder in irrigated areas, followed by shaftal (*Trifolium ruspdatum*) and berseem (*Trifolium alexandrianum*). Vetch (*Vicia spp*) and grasspea (*Lathyrus sativus*) are rain-fed crops in high altitudes. Maize (*Zea mays*) is the major summer crop. Few farmers use sorghum (*Sorghum vulgare*) and cowpea (*Vigna unquiculata*) for both grain and fodder. Most fodder seeds are purchased from local fodder markets. Seeding and fertilizer (organic and inorganic) application rates varied widely. Lack of land and quality seed, low-yielding fodder crop cultivars, and improper cultural practices are the major constraints to fodder production.

### 2.2.4 Milk processing

Women care for cows and sucking calves. They milk cows, process and sell milk and milk products. Butter is extracted from yoghurt using local churners which are time consuming, inefficient, and results in low quality dairy products, with short shelf-life and low market value.

## 2.3 Conclusions

Community-based participatory workshops involving the selected households were organized to characterize livelihoods. Baseline information was collected on forage and livestock production systems, feeds and feeding practices, and milk processing and the roles of women and men in the various processes.

### **Activity 3. Milk production and marketing survey**

#### 3.1 Procedures

A survey of milk production and marketing was carried out in Dahna-e-Ghori District in Baghlan Province, Afghanistan under the leadership of the Macaulay Institute. The aim of the survey was to ascertain milk production and marketing practices and to identify the key constraints to small scale producers participating in the market for milk and milk products.

The survey was carried out in five villages: Tapa-e-Sangank, Dan-e-Wakhshak, Qeshlak-e-Baikh, Bebe-Ghahwara and Nilan that were 27, 29, 31, 40 and 45 kilometers respectively from Pul-e-Khumri, the main market centre in the district. The villages varied in their access to Pul-e-Khumri, the main market centre in the District. Some villages had access to Pul-e-Khumri via tarred road (Tapa-e-Sangank, Dan-e-Wakhshak, and Qeshlak-e-Baikh), while in the case of others there was a dirt road or track to gain access to the tarred road.

A questionnaire was devised and translated into Dari. It was field tested by interviewing six householders and modified as a consequence. Approximately 20 householders in each of the five villages were selected. Interviews were carried out by four staff employed by the Aga Khan Foundation in Pul-e-Khumri, who had been previously trained. One of the interviewers was female and three were male. The female interviewer interviewed female respondents. All the interviews took place in May 2006.

#### 3.2 Results and achievements

##### *3.2.1 Livestock ownership*

Overall three quarters of households surveyed owned cattle. Generally the proportion of households with sheep was lower and the ownership of

goats was variable between villages. Of the households that owned cattle, the most common herd size was 2-4 cows, with the commonest flock sizes for sheep and goats being over 31 for both.

### *3.2.2 Milk production*

Majority of the households that owned cattle milked them, but few households milked sheep (Fig. 1.2). As would be expected average milk production from cows was highest in spring, and lowest in winter, with summer being intermediate (Fig. 1.3). Estimated milk yields were however low. Milk yield of goats and sheep averaged 1.68 and 0.73 kg/day respectively.

### *3.2.3 Livestock preferences*

Householders were asked to give their preferences for keeping different livestock species (cattle, sheep or goats). They were also asked to give their reasons for those preferences. Averaged across villages, 36%, 10% and 6% of the households preferred cattle, goat and sheep respectively. Most farmers preferred cattle because no family or hired labor is required for herding in the grazing areas, and they produce milk for home consumption. Some farmers preferred sheep because of the benefit of selling lambs.

### *3.2.4 Production and marketing of milk products*

Most households process cow milk into mainly yoghurt, chaka, butter and to a lesser extent kurut and cream (Fig. 4). Only 10% of the households interviewed sold milk or milk products because of lack of vehicles to transport their milk to the market and lack of electricity to keep it fresh. As low as 4% households exchanged their milk or milk products for other goods and services (1.5). Majority of the households gave away their milk or milk products to other households, in keeping with Afghan tradition.

## 1.3 Conclusions

Cattle were preferred to sheep and goats because cattle keeping do not require labour for herding, and cattle produce milk for household consumption and for sale. Many families had 2-4 cows. Milk production was highest in spring, and lowest in winter, with summer being intermediate. Yoghurt, chaka, and butter were the main milk products. Only 14% of the households sold or exchanged milk or milk products because of lack of transport to markets and inability to keep fresh milk. In

contrast over 80% of households gave milk or milk products to other households in the village.

### 3.3. Implications of results and achievements

The project reached out to 525 more households than originally planned, meaning that the project was highly successful and could have impact on far more rural communities than originally planned. The farmers associations consisting of men and women in 600 households formed by the project facilitated knowledge exchange and transfer, especially to the women folk who had limited access to information and knowledge sharing. The associations also provided the social capital and networks for the implementation of the project.

Main constraints to increased forage production were lack of quality seed, poor access to quality seed, improved cultivars, and appropriate agronomic practices. Milk production was also constrained by poor feeding, inefficient processing methods, and poor market access. The implication is that, participatory approaches and multi-stakeholder partnerships involving community-based institutions and research and development agencies will be required to improve rural livelihoods based on smallholder dairying. The strategy should be based on integrated crop-livestock production with a strong capacity building component, especially building the capacity of women who manage milking cows, process and sell milk. Provision of cheaper methods of transportation of milk and milk products to markets and to processing and storage of excess milk in spring to optimize income should also be given priority. The smaller number of cows per family suggested that household milk processing methods would be more appropriate.

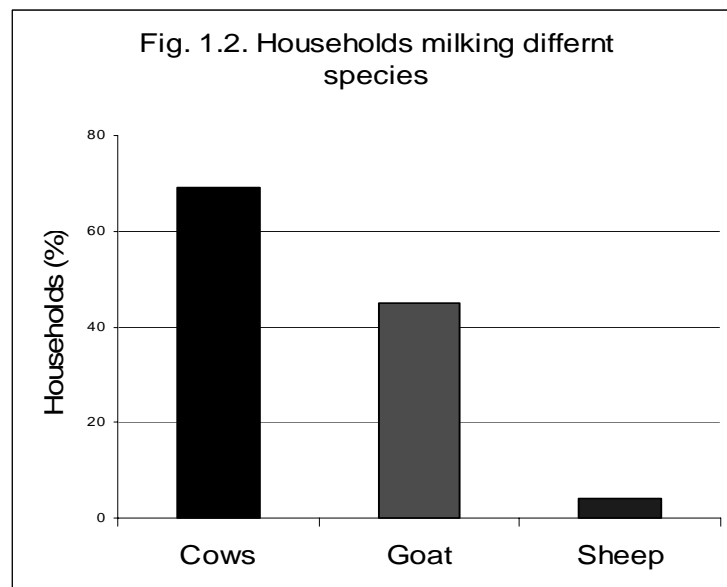
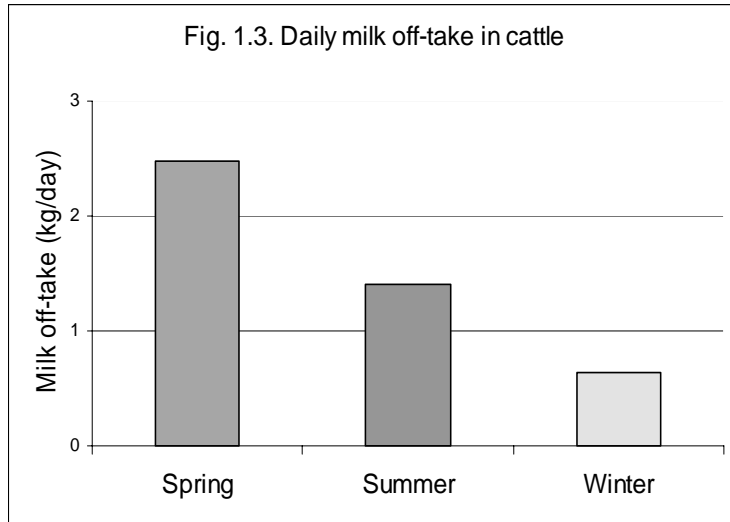
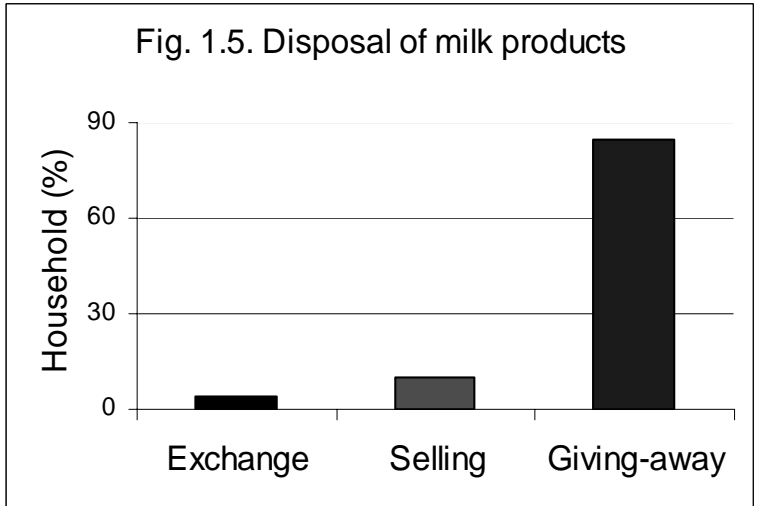
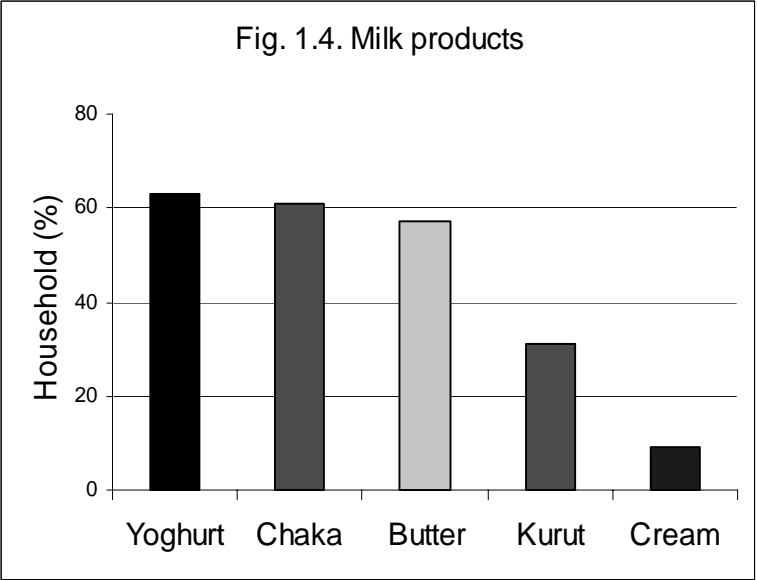


Fig. 1.3. Daily milk off-take in cattle





## **Output 2: Best practices to increase forage production**

### **2.1 Introduction**

Thriving fodder markets in most peri-urban and urban centers provide opportunities for farmers to produce fodder to generate income and improve their livelihoods. Fodder production and conservation could also reduce the feed gaps. Alfalfa (*Medicago sativa*), Persian clover (*Trifolium resupinatum*) and Egyptian clover (*T. alexandrinum*) are the wide-spread fodder legumes for hay and fresh fodder to supplement low-quality cereal straw diets, especially in winter. Integration of the nitrogen-fixing legumes into the smallholder crop-livestock farming systems could improve soil fertility and boost crop yields. They could also be fed as protein supplements to low-quality cereal straw diets to improve nutrition of milking cows, thereby increasing milk production and household food security.

Forage yields on farmers' field is generally low because they use poor quality seed, low-yielding varieties and in proper cultural practices. The cultivars of forage crops, rates of seeding, and the types and amounts of animal manure, nitrogen and phosphorus fertilizers used varied among the households. Best practices for growing forage crops, including seeding rate, and rates of animal manure and phosphorus fertilizer application rates were demonstrated on farmers' fields. In addition, on-station trials were also conducted to compare cultivars of different species of forage crops in order to identify high yielding fodder crop varieties. Furthermore, quality seed production was demonstrated, and seeds of fodder crops were multiplied and distributed to households to increase fodder production.

### **2.2 Activities implemented**

#### **Activity 1. On-farm demonstration of best forage production practices**

##### 1.1 Procedures

Farmer-participatory trials were conducted to demonstrate the effects of good agronomic practices on fodder yield of alfalfa and berseem using farmers' practices as controls over two cropping seasons – 2005/06 and 2006/07 cropping seasons. The cultural practices demonstrated included:

1. Seeding rate
2. Manure application rate
3. Phosphorus application rate
4. Manure and phosphorus application

The project provided inputs (seeds and fertilizer) through the farmers' interest

groups. Farmers established and managed the plots. Generally, farmers planted alfalfa and berseem during February-March at a seeding rate of 35 kg/ha for both species on plots measuring 200-500 m<sup>2</sup>. Alfalfa was harvested during May-November and berseem during May-July.

The project staff made weekly farm visits during the growing season to provide technical backstopping and monitor farmers' preferences and perceptions. They also visited on days when farmers are harvesting their crops to estimate forage yield. On each farm, 3-4 quadrats of size 50 cm x 50 cm were taken per treatment and weighed, and air-dried to estimate fodder yields. Field days were organized for members and non-members of the farmers' interest groups to explain the results and document farmers' opinions about the practices.

#### *1.1.1 Seeding rate*

The effects of seeding alfalfa at 25 and 35 were compared with current farmers' practice of 45 kg/ha on four farms. On each farm, the farmers divided their field into three equal parts and randomly assigned the three seeding rates to the plots. The crop on each farm was cut 6 times to estimate green fodder yield.

#### *1.1.2 Animal manure*

The effect of applying 6 and 9 t/ha of dried animal manure on alfalfa fodder production was compared with the farmers' practice of 3 t/ha. Farmers divided their fields into three equal plots, and randomly assigned the different manure rates to each of the plots. The dried cow dung was mixed with the top soil before planting. The crop on each farm was cut 6 times during the demonstration period.

#### *1.1.3 Phosphorus fertilizer*

The effects of 50, 100 and 200 kg P/ha applied as di-ammonium phosphate on forage yield of alfalfa and berseem were demonstrated on three farms. The farmers' fields were divided into three equal plots and each plot randomly assigned to the three phosphorus rates. The phosphorus was mixed with the top soil before planting. Alfalfa was cut four times and berseem was cut three times during the trial period.

#### *1.1.4 Animal manure and phosphorus fertilizer*

The effect of applying 3t/ha animal manure with either 50 kg P/ha and 100 kg P/ha on berseem fodder production compared with the farmers' practice of applying only 3t/ha of manure alone on two farms. The manure and phosphorus were broadcasted and mixed with the top soil before planting berseem. Forage yield was estimated from four cuts.

#### *1.1.5 Statistical analyses*

Data was analyzed across cuts as a randomized block design with farms as replicates.

## 1.2 Results and achievements

On each farm, fodder yield generally increased in response to increasing seeding rate (Fig. 2.1), animal manure (Fig. 2.2), phosphorus fertilizer (Fig. 2.3), and manure plus phosphorus (Fig. 2.4).

Table 2.1 presents average fodder yields of the trials summed across farm. As Fodder yield of alfalfa seeded at a rate of 35 kg/ha was similar ( $P < 0.05$ ) to the seeding rate of 45 kg/ha currently used by farmers, meaning that farmers could cut down production cost by using the 35 kg/ha seeding rate (Fig. 2.1).

Manuring at 6 and 9 t/ha produced more ( $P < 0.05$ ) fodder than at 3 t/ha (Fig. 2.1). Phosphate fertilizer applied at 100 and 200 kg/ha produced significantly higher fodder than when a rate of 50 t/ha (Fig. 2.3). Applying manure alone at 3t/ha resulted lower ( $P < 0.05$ ) fodder yield than when the same amount of manure was combined with phosphate fertilizer at 50 or 100 t/ha (Fig. 2.4).

## 1.3 Conclusions

Farmers in Baghlan and similar environments and farming systems cut down cost of fodder production and increase fodder production by adopting proper cultural practices. These include: seeding alfalfa at 35 kg/ha instead of the current practice of 45 kg/ha, mixed 6-9 t/ha of animal manure, or 3 t/ha of animal manure with 50-100 kg P/ha to the top soil before planting alfalfa and berseem. Because, such management practices were perceived as resulting in better establishment, lower weed density, higher fodder yields, and potentially more milk off-take when the fodder is eventually fed to milking cows.

Fig. 2.1. Seeding rate effects on fodder yield of alfalfa, on-farm

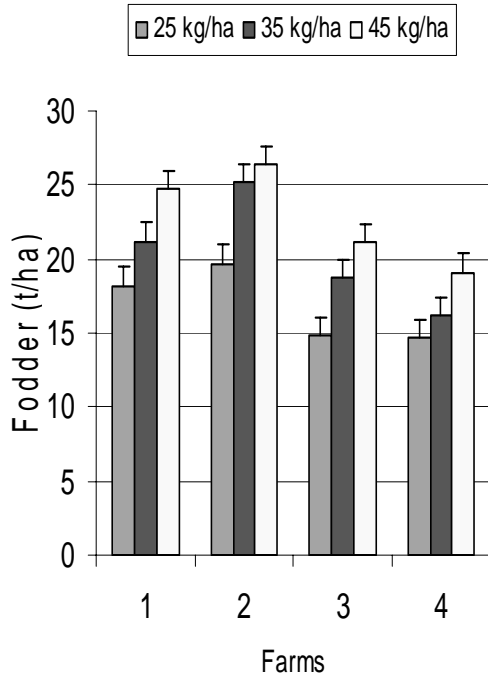
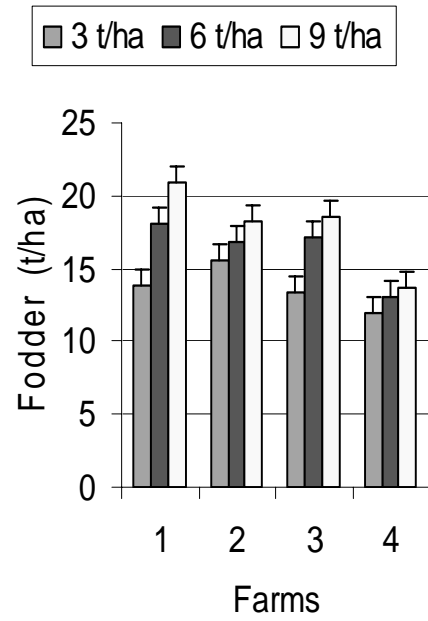


Fig. 2.2 Animal manure effects on alfalfa fodder yield, on-farm



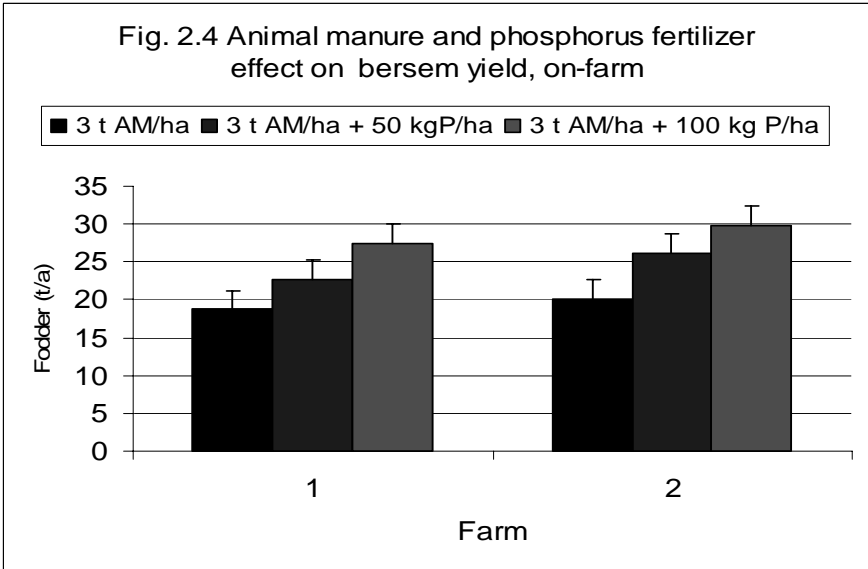
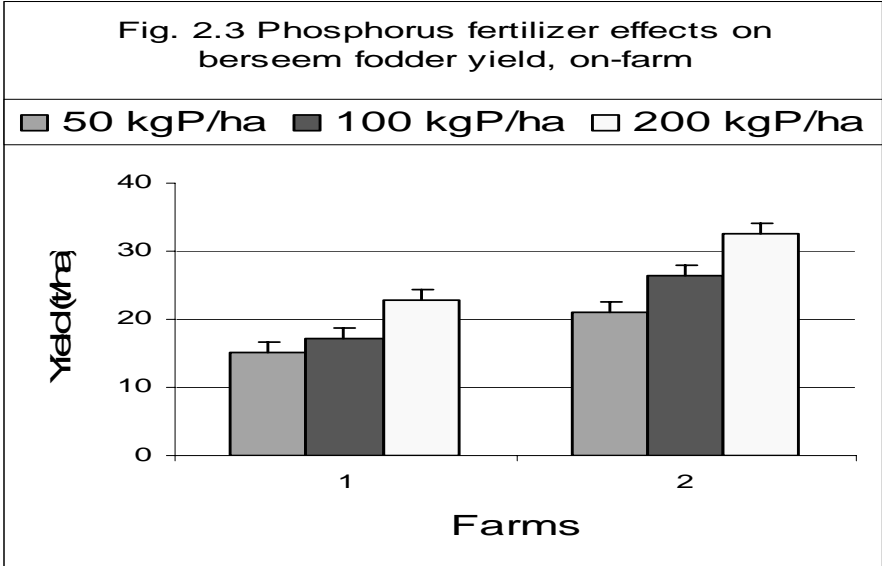


Table 2.1  
Cultural practice effects on on-farm fodder yield of alfalfa and berseem

Trial	Treatment	<sup>1</sup> Fodder yield
1	Seeding rate (kg/ha)	<sup>2</sup> Alfalfa
	25	16.8 c
	35	20.8 b
	45	22.8 b
	s.e.	1.41
2	Animal manure (t/ha)	<sup>3</sup> Alfalfa
	3	13.7 a
	6	16.2 b
	9	17.9 b
	s.e.	0.48
3	Phosphorus (kg P <sub>2</sub> O <sub>5</sub> /ha)	<sup>4</sup> Berseem
	50	18.1 c
	100	21.8 b
	200	27.1 a
	s.e.	0.451
4	Manure and phosphorus	<sup>5</sup> Berseem
	Manure (3t/ha)	19.3 c
	Manure + 50 kg P <sub>2</sub> O <sub>5</sub> /ha	24.2 b
	Manure + 100 kg P <sub>2</sub> O <sub>5</sub> /ha	28.6 a
	s.e	0.74

<sup>1</sup>Means with different letters differ (P<0.05).

<sup>2,3</sup>Alfalfa: Average 6 cuts on 4 farms.

<sup>4,5</sup>Berseem: Average 3 cuts on 2 farms during the 2006 and 2007.

## Activity 2. On-station evaluation of forages

### 2.1 Procedures

#### 2.1.1 Alfalfa

Fodder yield of 13 alfalfa cultivars (ICARDA-54, ICARDA-535, ICARDA-597, Barlydia, Campagnola, CUF, Kysari, Legend, Meldor, Prime, Sceptre, Sequel, Verdor) were compared with a local variety during 2005-2007. The cultivars were planted on 15<sup>th</sup> October, 2005 using a randomized block design with three replicates and a plot size of 2 m x 3 m. Each plot received 115 kg P/ha as diammonium phosphate and 45 kg N/ha as urea at establishment. Six cuts were taken each year during May-November 2005, and April-August 2007. At each harvest, four quadrats of size 0.25 m<sup>2</sup> taken at 5 cm above ground in each plot and air dried to estimate fodder yield. Plots were flood irrigated each week during the growing period.

#### 2.1.2 Clover

Fodder yield of seven clover (*Trifolium*) species, namely: *T. alexandrinum* cv. Agaiti and Masakawi, *T. angustifolium*, *T. cherleri*, *T. haussknechi*, *T. pilulare*, *T. purpureum*, and *T. scabrium* were compared with *Trifolium resupenatum* cv. Shaftal which is grown by most farmers in the target area as control during 2005/06 and 2006/07 planting seasons. The entries seeded at a rate of 25 kg/ha in October each year using a randomized block design with three replicates and plot sizes of 2 m x 3 m. Each plot received 115 kg P<sub>2</sub>O<sub>5</sub>/ha as diammonium phosphate and 45 kg N/ha as urea at establishment. Four cuts were taken during April-July each year. At each cut, four quadrats of size 0.25 m<sup>2</sup> were harvested at 5 cm above ground in each plot, weighed, and air dried to estimate fodder yield. Plots were flood irrigated each week during the growing period. Surviving species after the fourth cut were allowed to seeds, and harvested to estimate seed yields.

#### 2.2.3 Vetch and grasspea

Annual forage legumes such as common vetch (*Vicia sativa*), narbon vetch (*V. narbonensis*) and grasspea (*Lathyrus sativus*) have potential to fill seasonal feed gaps in Afghanistan. But limited research has been conducted to identify adapted and high-yielding varieties. Elite entries of grasspea (445, 476, 519, and 527), common vetch (2064, 2556) and narbon vetch (2380, 2383, and 2561) were imported from ICARDA in Aleppo, Syria. Their hay, straw and grain yields were compared with those of a local common vetch variety (control) during the 2005/06 and 2006/07 growing seasons. They were seeded in October 2005 and

November 2006 at 80 kg/ha using a randomized block design with three replications and plots measuring 2 m x 3 m. Each plot received 60 kg P<sub>2</sub>O<sub>5</sub>/ha as diammonium phosphate and 80 kg N/ha as urea at establishment. Half of the plots were cut at 50% flowering to estimate hay yield, and the remaining half were harvested at maturity to estimate straw and grain yields. At each cut, three quadrats of size 0.25 m<sup>2</sup> were harvested at 5 cm above ground in each plot, weighed, and air dried to estimate yield. Plots were flood irrigated each week during the growing period.

#### 2.2.4 Cowpea

Afghan farmers grow cowpea (*Vigna unguiculata*) to produce grain for human consumption and fodder for livestock feed. Although the fodder yields of cowpea grown by farmers in Afghanistan are low, little research has been done to identify high-yielding dual-purpose varieties. Fodder and grain yields of 13 early-maturing (Trial 1) and 13 medium-maturing (Trial 2) cowpea entries introduced from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, were compared with a local variety.

The entries were seeded in rows 1-m apart and 0.25 m between rows at two seeds per hole in May 2006 and June 2007. A randomized block design with three replicates and plot sizes of 2m x 3m for the early-maturing and 3m x 3m for the medium-maturing was used. Each plot received 60 kg P<sub>2</sub>O<sub>5</sub>/ha as diammonium phosphate at planting, and sprayed against cutter-worms and aphids. Plots were flood irrigated each week during the growing period. Pods were hand-picked as weekly, air-dried, bulked by plot and weighed. The pods were shelled to estimate grain yield. The plants were harvested at ground level after the last harvesting of pods, weighed and air-dried to estimate fodder yield.

#### 2.2.5 Sorghum

Although farmers in the target area grow sorghum (*Sorghum vulgare*), only few use it for fodder. Most of the sorghum is used to produce brooms. Therefore, fodder production of 32 sorghum entries imported from the International Center for Research in the Semi-Arid Tropics (ICRISAT), India was compared with a local variety as control.

The entries were planted in 2-m long rows separated by 1-m paths in May 2006 and June 2007 using a randomized block design with three replicates. The seeds were planted 0.25 m apart within rows with two seeds per hole. At planting, 60 kg P<sub>2</sub>O<sub>5</sub>/ha as diammonium phosphate and 23 kg N/ha as urea were applied. Plots were sprayed with an insecticide (Dinadiol) against stem-borers, and flood irrigated each week during the growing period. The plots were harvested eight weeks after planting at 10 cm above ground, and the regrowth was harvested twice at four weeks intervals to estimate air-dried fodder yield.

#### 2.1.6 Statistical analyses

Data was analyzed as a randomized block design using the General Linear Models procedures.

## 2.2 Results and achievements

### 2.2.1 Alfalfa

Averaged over 12 cuts, fodder yields of alfalfa entries Aleppo-579, CUF, Prime, Sequel, Verdor, Sceptre, and Legend was higher ( $P<0.05$ ) the local cultivar (Fig. 2.5).

### 2.2.2 Clovers

Forage yield varied ( $P<0.05$ ) among the clover species during the first (Fig. 2.6.1), second (fig. 2.6.2), third (Fig. 2.6.3) and the fourth (Fig. 2.6.4) cuts. Two species, *T. alexdranum* and *T. resupenatum* persisted after the fourth cut and were allowed to produce seeds.

The two Egyptian clover cultivars, Agaiti and Masakawi produced more ( $P<0.05$ ) than *T. resupenatum* cv. Shaftal which is grown by most farmers in the target area (Table 2.2). Discussions during a field days showed that farmers preferred the persistent species, so seeds of the two species were multiplied and distributed to interested farmers.

Table 2.2

#### Seed yield of clover species

Species	<sup>1,2</sup> Seed (t/ha)
<i>T. resupinatum</i> (Shaftal)	0.99 c
<i>T. alexandrinum</i> cv Maskawi	1.63 b
<i>T. alexandrinum</i> cv Agaiti	2.04 a
s.e.	0.295

<sup>1</sup>Means in a column with different letters differ ( $P<0.05$ ).

<sup>2</sup>Values are averages of 2 growing seasons.

### 2.2.3 Vetch and grasspea

Hay yields of the common vetch entry 2064 and narbon vetch entries 2383 and 2561 were greater ( $P<0.05$ ) than the yields of the control (Fig. 2.7). The grasspea and narbon vetch entries produced more ( $P<0.05$ ) hay than the common vetch entries. Straw yields of grasspea entries 445 and 476 were greater ( $P<0.05$ ) than the straw yields of the control, while grain yields of grasspea entries 445 and 476 and common vetch entry 2064 were higher ( $P<0.05$ ) than grain yields of the local

variety (Fig. 2.8). The average straw and grain yields of the grasspea lines were higher ( $P<0.05$ ) across species than the common and narbon vetch entries.

#### 2.2.4 Cowpeas

Fodder and grain yields varied ( $P<0.05$ ) among the early-maturing (Fig. 2.8.1) and medium-maturing (Fig. 2.8.2) entries. Fodder yields of early-maturing entries IT99K-529-1 and IT93K-4521, and grain yields of entries Syrian IT3K-452-1 and IT96D-610 were greater ( $P<0.05$ ) than the local variety. Eight of the introduced medium-maturing entries had higher ( $P<0.05$ ) fodder yields than the local variety. The grain yield of the local variety was greater than the yields of the four of the introduced entries.

#### 2.2.5 Sorghum

Fodder yield (Fig. 2.9.1) and tiller numbers (Fig. 2.9.2) differed ( $P<0.05$ ) widely among the sorghum lines, with most of the introduced lines yielding significantly more fodder than the local line. Promising lines for fodder production included: PVK-801, FM-48, ICSV-700 and GD-65118.

### 2.3 Conclusions

Farmers in Baghlan province, north-west Afghanistan and similar environments could produce more fodder in winter by using alfalfa entries Aleppo-579, CUF, Prime, Sequel, Verdor, Sceptre, and Legend; and Egyptian clover cultivars Agaiti and Masakawi. Common vetch entry 2064, narbon vetch entry 25661, 2383 and grasspea 476 could be used for improved hay production, while common vetch entry 2064 and grasspea 445 and 467 can be used for improved grain and straw production.

In summer, early-maturing cowpea entries IT93K-452-1, IT96D-610, IT97K-568-18, IT98K-589-2, IT98K-506-1, IT00K-898-5 and IT98K-205-8; and medium-maturing entries IT00K-901, IT98K-205-15, IT97K-499-35, IT97-556-4 and IT97-1069-6 have potential for fodder and grain production. Sorghum PVK-801, FM-48, ICSV-700 and GD-65118 also have potential for fodder production.

Fig. 2.5 Yield of alfalfa entries - average of 12 cuts

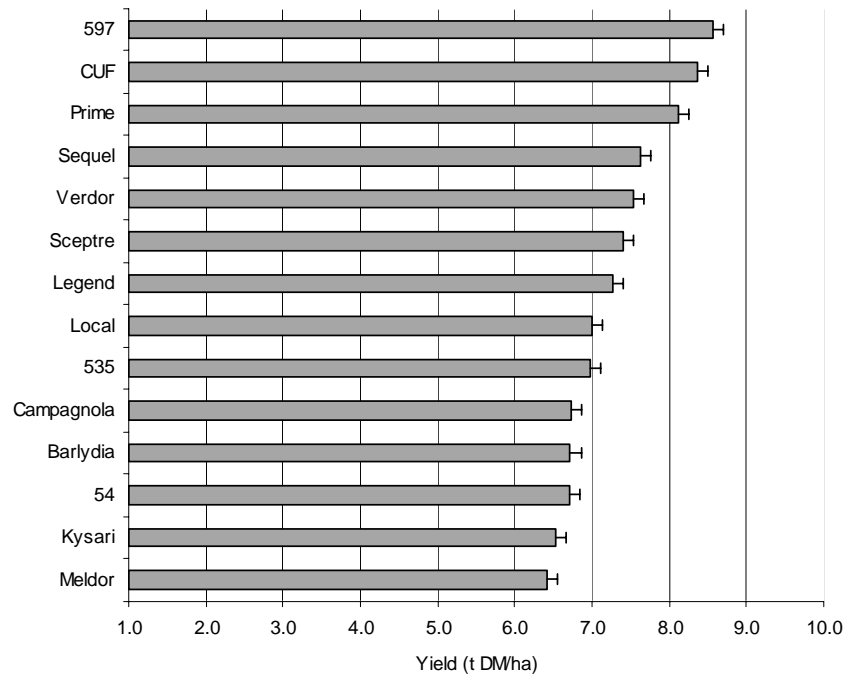


Fig. 2.6.1. First cut yield of clovers Baghlan-Afghanistan, 2-year mean

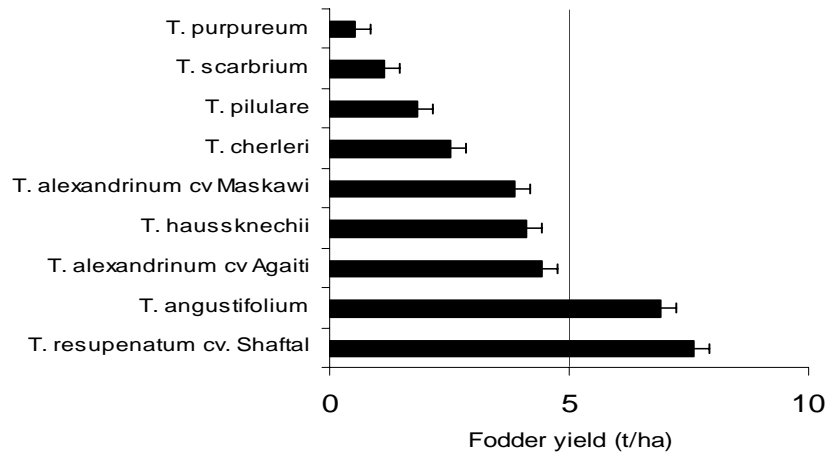


Fig. 2.6.2. Second cutr yield of clovers, Baghlan-Afghanistan, 2-year mean

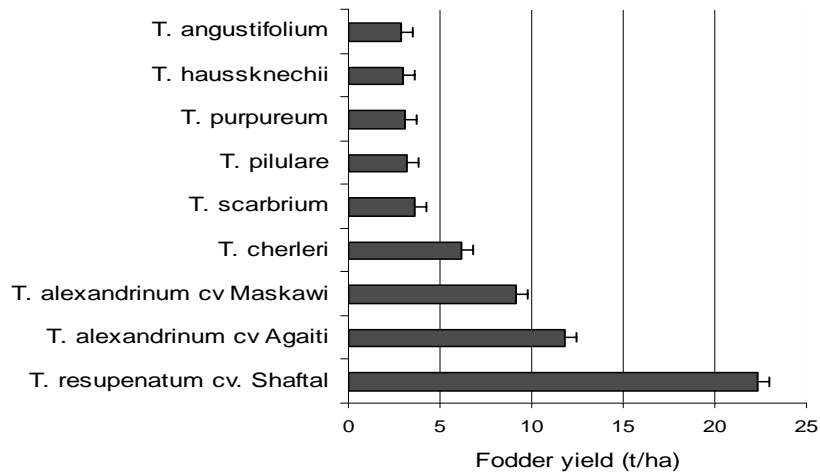


Fig. 2.6.3. Third cut fodder yield of clovers, Baghlan-Afghanistan, 2-year average

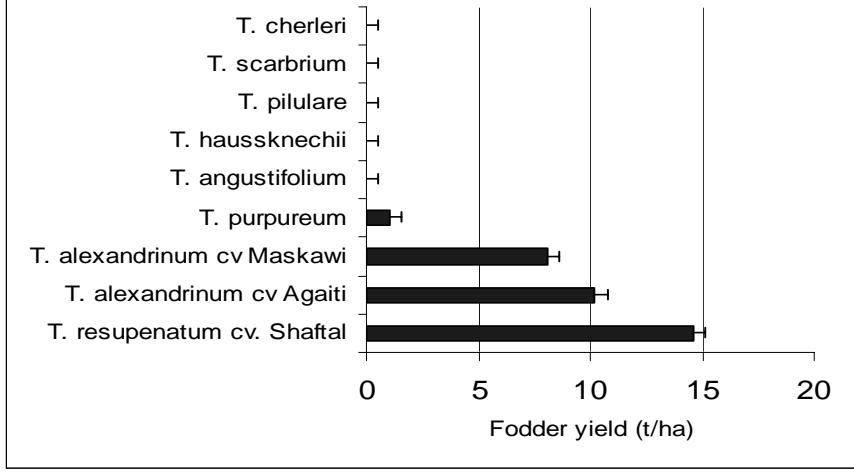


Fig. 2.6.4. Fourth cut fodder yield of clovers, Baghlan-Afghanistan, 2-year mean

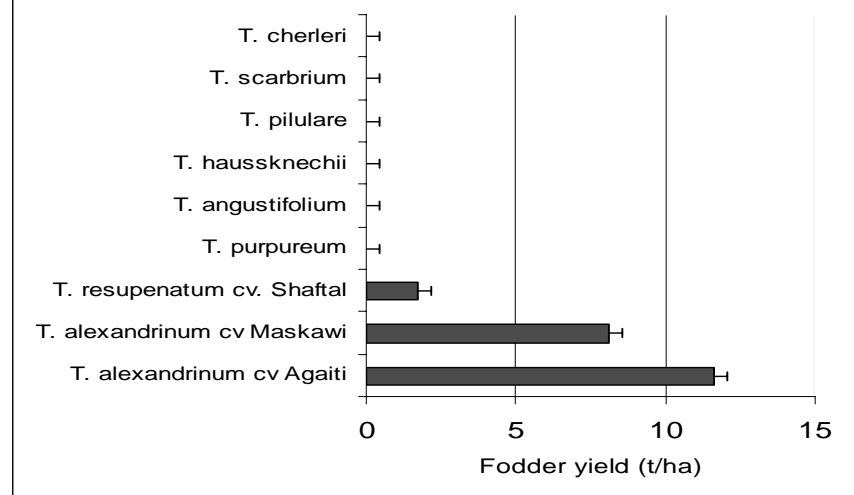


Fig. 2.7.1. Hay yield of *Lathyrus* and *Vicia* entries, Baghlan-Afghanistan

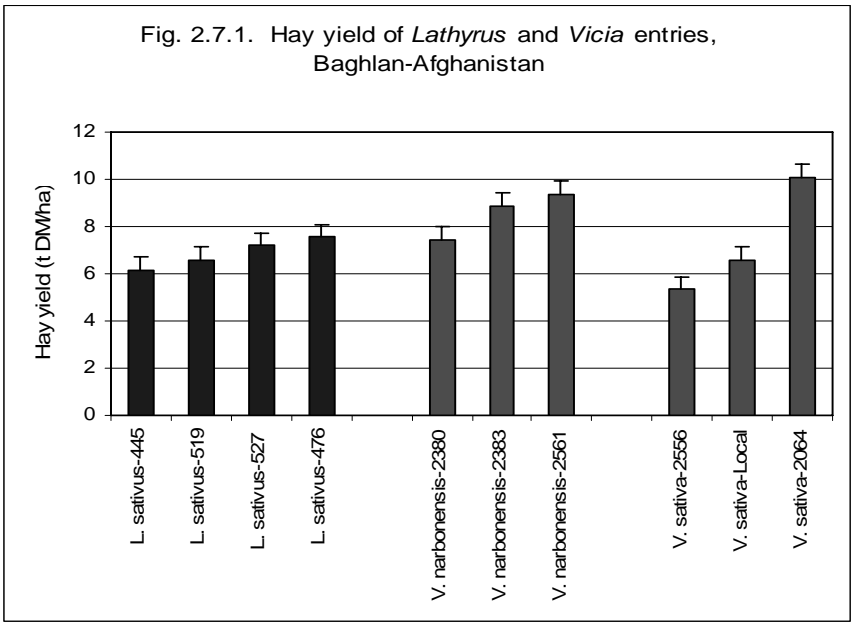
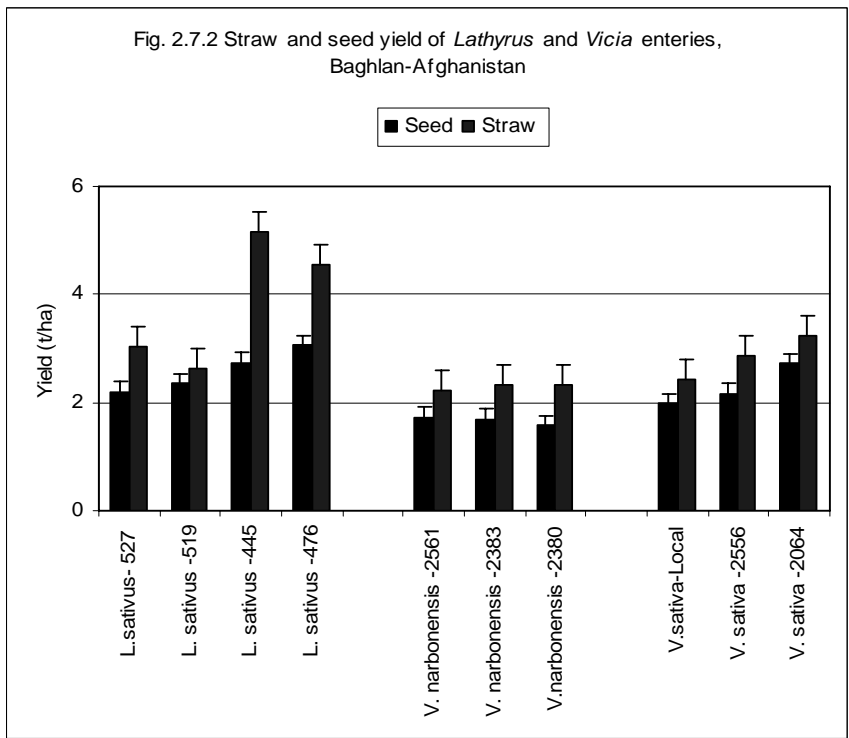


Fig. 2.7.2 Straw and seed yield of *Lathyrus* and *Vicia* entries, Baghlan-Afghanistan



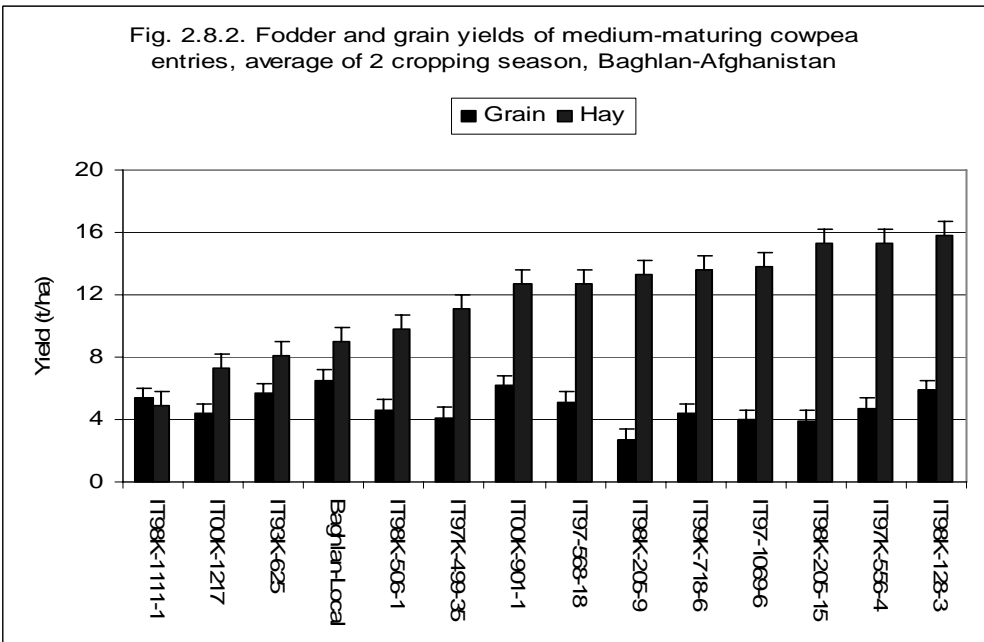
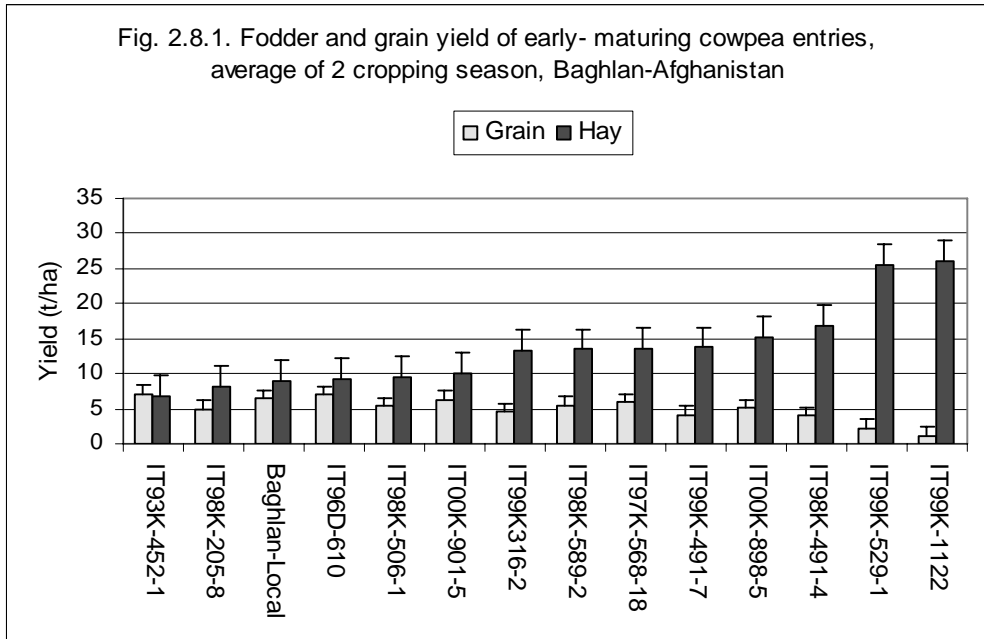


Fig. 2.9.1 Fodder yield of sorghum varieties in Baghlan - mean of 3 cuts and 2 growing seasons

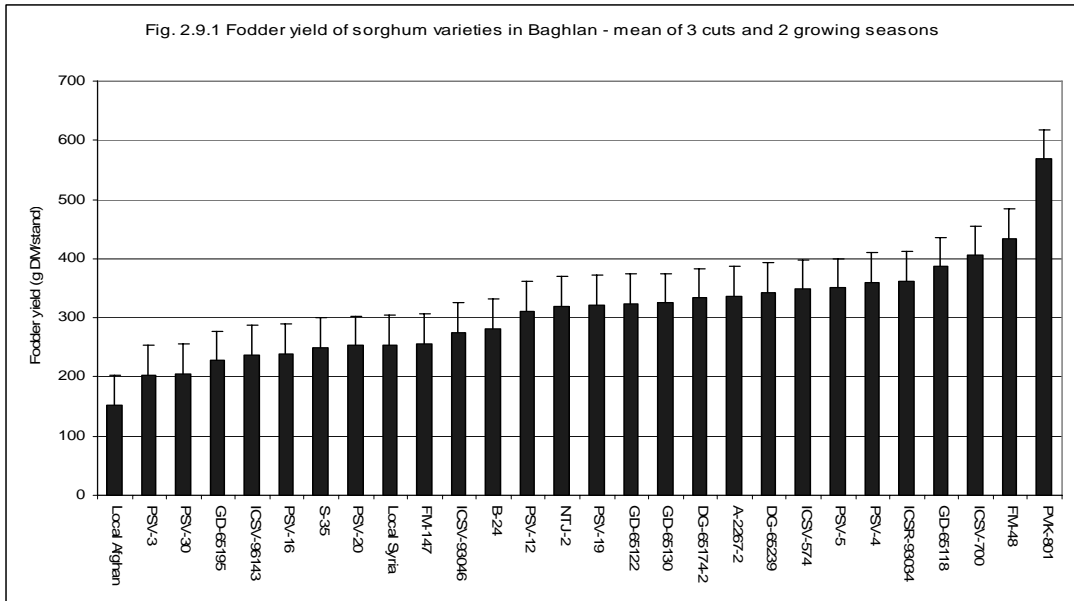
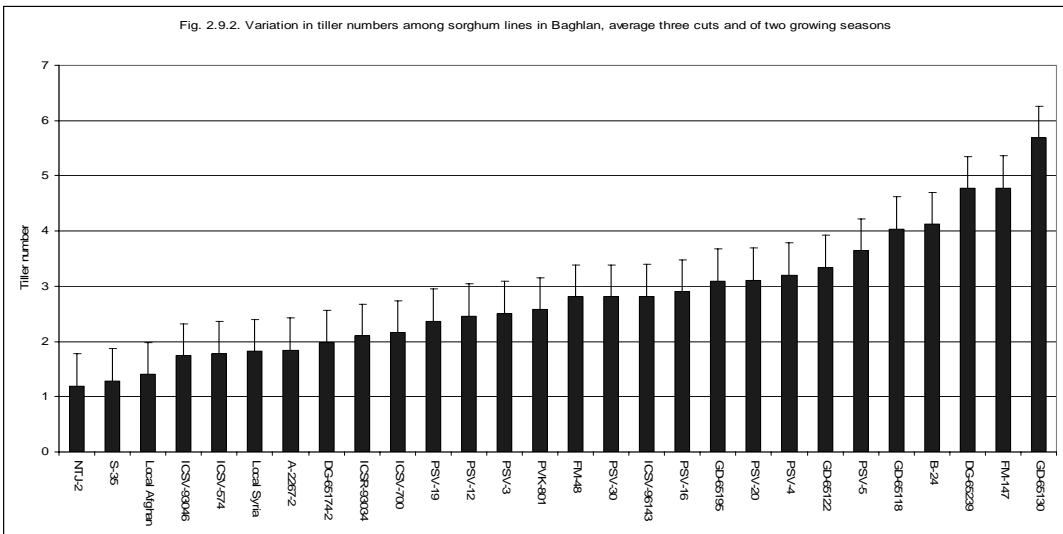


Fig. 2.9.2. Variation in tiller numbers among sorghum lines in Baghlan, average three cuts and of two growing seasons



### **Activity 3. Forage seed production and distribution**

#### 3.1 Procedures

The project produced quality seed through contract farmers. Three farmers were contracted to produce berseem seeds. The project provided the farmers with inputs and technical back-stopping. Seeds and straw from the contract farmers were purchased by the project. Also, small quantities of grasspea, common vetch, narbon vetch, oats, cowpea and alfalfa were produced from the on-station experiments. Seeds produced were distributed to interested farmers through the farmers' associations. Land area planted to forages and farmers' opinions about the seed were monitored during farm visits, farmers' field days, and women's field days.

#### 3.2 Results and achievements

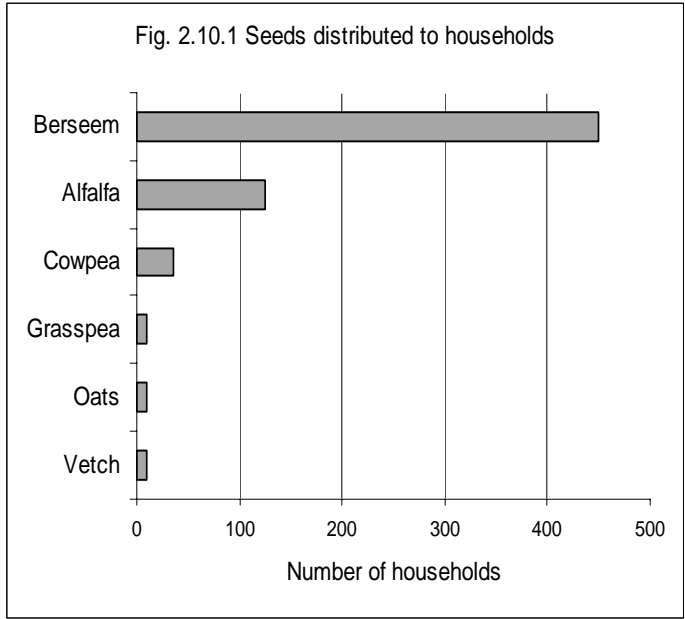
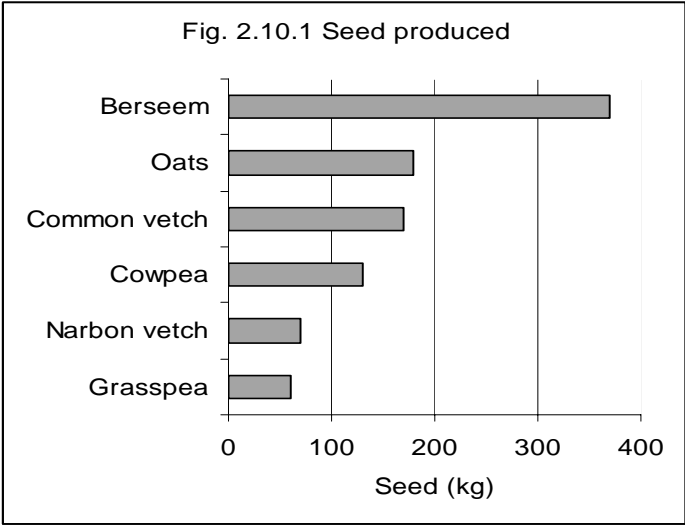
About one ton of seeds of different fodder crop species was produced (Fig. 2.10.1) and distributed to more than 500 households (Fig. 2.10.2). A feedback from farmers showed that about 25 ha of land area was planted with the seed during the project period. The improved seeds helped them to produce more fodder from a unit land area.

#### 3.3 Conclusions

The project produced and distributed quality seed to about 500 households to partly overcome the seed constraint, which helped farmers to produce more fodder and seed improve fodder production per unit area of land.

### **2.3 Implications of results and achievements**

Farmers in Baghlan province and similar environments could increase alfalfa and berseem fodder yield by using improved cultural practices. High-yielding cultivars of alfalfa, clover, vetches and grasspeas, cowpea and sorghum were identified which when adopted by farmers could increase fodder yield thereby improving the nutrition of milking cows and growing calves. Higher milk yield could improve household food security, especially nutrition of women and children. Milk above household needs could be processed and sold to generate income, thereby improving the wellbeing of women who care for, and milk cows and process and sell milk and dairy products. Integration of the forage legume into the cropping systems could also improve soil nitrogen for crop production. Further research is needed to test their performance on farmers' fields, and to assess their contributions to household food security.



## **Output 3: Feeding packages to increase milk production**

### **3.1 Introduction**

The community discussions and farm visits showed that poor feeding of milking cows and replacement heifers both in winter and summer reduces the performance of cattle kept for milk, land cultivation, dung, and fuel by farmers. Most farmers hand-feed their cattle with low-quality wheat straw supplemented with different amounts of nitrogen-rich oil-seed cakes forage legume hay, and food legume haulms. Similarly, cattle grazing low-yielding and poor quality native pastures (NP) in summer are fed different amounts of green forage legume fodder and oil-seed cakes as supplements. Feeding cost accounted for about 60-80% of the total production cost. Yet, data on the effects of supplementation on milk off-take and growth rates of cow and calves is limited. Such information is needed by farmers to either to develop economic rations based on locally-available feed resources or to make decisions on feeding systems to reduce production cost and increase net profits from the sale of animal products. It is also needed by funding agencies to formulate development projects.

Most farmers traditionally do not chop fodder before feeding it to their animals. For milking cows, this practice could affect the quantity of feed eaten and ultimately the amount of milk they produced for household consumption and sale. Those who chop fodder before feeding use do so by hand which is tedious and time consuming. Simpler and faster chopping methods are needed to reduce household workload and improve the use of fodder for milk production. Therefore, the project introduced and tested a hand operated fodder chopper.

Since women are responsible for the day-to-day management of the milking cow and calf, on-farm trials were conducted with the women interest groups to demonstrate the effect of better feeding practices on milk off-take and growth rate of cattle under village conditions. The trials also demonstrated the best feeding practices based on locally available feed resources.

### **3.2. Activities implemented**

A summary of the trials is presented in Table 3.1. Six trials were conducted with farmers in the selected communities in winter (Trials 1, 2 and 3) and summer (Trials 4, 5 and 6).

#### **Activity 1. On-farm demonstration of winter feeding practices**

##### 1.1 Procedures

##### *1.1 Farmer selection and training*

Farmers were selected through the various farmers' interest groups. Meetings

were held with the farmers' associations in each village to explain the objectives and procedures for the trials, and criteria for the selection of interested households. Interested farmers were expected to: have at least one milking cow and growing calves, land for growing forages, space for storing supplements, labor for feeding, and willing to be trained. Interested households were selected by the leaders of the association and the project staff.

### *1.2 Estimates of milk off-take and liveweight gain*

Female members of the interested households were trained to weigh and feed the right amount of supplement, and to measure and record milk off-take. The women were given note-books, pencils and calibrated plastic cups to estimate milk off-take in the morning and afternoon of each day.

Male members of the households were trained to estimate liveweight of cattle using the measuring tape. Girth length of each cow and calf were estimated every 14 days with a measuring tape and converted into kilograms. Average daily gain for each animal was estimated as the final weight minus the initial weight divided by the duration of the trials in days. Total daily gain was estimated as the sum of the average daily gains of the cows and calves on each treatment.

Meetings were held with participating households at the start of each trial to explain the objectives of the trial, the data required and how the data should be recorded. The first two 14 days of each trials was considered as an adjustment period where the animals get used to the feed.

### *1.3 Management and feeding*

The project staff and leaders of the farmers' interest groups estimated the duration and quantities of the various supplements that may be needed for the trial period. They purchased the supplements and transported it to the various villages. The supplements were then distributed to the participating household. They stored, weighed and fed the required amount daily. Generally, all the supplements were eaten so there were none left to be weighed after feeding.

### *1.4 Forage legume hay as a supplements to wheat straw basal diet in winter*

Trial 1 evaluated the effect of supplementing a basal diet of wheat straw with berseem and alfalfa hays and mungbean haulms on the milk yield and growth rates of cows and suckling calves (cow-calf pairs) under village conditions during the winter months of December 2006-March 2007 in Baghlan Province, north-west Afghanistan. Penned cow-calf pairs with free access to wheat straw and water were used. The legume forage hay and haulms were chopped into 3-5 cm pieces and presented in a separate feeding trough. Mung-bean hay contained 3-5% pods and grains. Each cow-calf pair was given 10 kg legume daily from 19:00 to 07:00 hours the next day. Milk off-take from each cow was recorded

twice daily in the morning and evening, and liveweights of the cows and calves were estimated separately every 14 days.

### *1.5 Cotton seed cake as a supplement to wheat straw basal diet in winter*

Trial 2 evaluated the effect of a daily supplementation of 2, 3, 4 kg CSC per cow-calf pair on the milk off-take and growth rates of pen-fed cow-calf pairs fed a basal diet of wheat straw under village conditions in Baghlan Province. The feeding and data collection procedures used were similar to those described under Trial 1 above.

### *1.6 Flax seed cake as a supplement to wheat straw basal diet in winter*

Trial 3 evaluated the effect of a daily supplementation of 2, 3, 4 kg FSC per cow-calf pair on the milk off-take and growth rates of pen-fed cow-calf pairs fed a basal diet of wheat straw under village conditions in Baghlan Province. The feeding and data collection procedures used were similar to those described under Trial 2 above.

### *1.7 Statistical analyses*

All data were analyzed using the General Linear Models procedures. Milk yield data from Trials 1, 2 and 3 were analyzed as a randomized complete block using initial milk yield of the individual cows as a covariate. A similar design was used for the total daily gain data using the average of the initial weight of the cows and calves as covariates.

## 1.2 Results and achievements

### *1.2.1 Forage legume hay and haulms*

In Trial 1, the average milk off-take of cow-calf pairs supplemented with berseem hay was 17% higher ( $P < 0.05$ ) than those fed with alfalfa hay and mung-bean haulms (Table 3.2). Those fed with berseem or alfalfa hay grew faster ( $P < 0.05$ ) than those fed with mung-bean haulms.

### *1.2.2 Cotton seed cake*

Cow-calf pairs fed with either 3 kg or 4 kg CSC daily produced at least 12% more ( $P < 0.05$ ) milk, and grew faster ( $P < 0.05$ ) than those fed with 2 kg CSC daily (Table 3.3). However, cow-calf pairs fed 3 kg or 4 kg per day did not differ ( $P > 0.05$ ) in milk off-take and daily gain.

### *1.2.1 Flax seed cake*

Similarly, the milk off-take and daily gain of cow-calf pairs fed with 3 kg or 4 kg

FSC daily were similar ( $P < 0.05$ ), but greater ( $P < 0.05$ ) than those fed with 2 kg FSC daily (Table 3.4).

### 1.3 Conclusions

Farmers could supplement cow-calf pairs on a basal diet of wheat straw under village conditions in Baghlan Province or areas with environmental conditions and farming systems with berseem hay or 2–3 kg of either CSC or FSC to improve milk off-take and growth rates during winter.

## **Activity 2. On-farm demonstration of summer feeding practices**

### 2.1 Procedures

The farmer selection and training procedures were similar to those used in the winter feeding trials (see sessions 1.1.1, 1.1.2, 1.1.3)

#### *2.1.1 Cotton seed cake as a supplement to native pasture grazing*

Trial 4 compared growth rates of cows and suckling calves (cow-calf pairs) grazing NP alone with those grazing NP supplemented with different amounts of cotton seed cake (CSC). The cow: calf pairs grazed native pastures from 05:00 – 09:00 hours in the morning, and from 15:00–18:00 hours in the afternoon each day. Half of the supplement was given between the grazing periods, and the other half was given after grazing from 19:00 to 05:00 hours the next day. Milk off-take was recorded in the morning and evening of each day.

#### *2.1.2 Flax seed cake as a supplement to natural pasture grazing*

Trials 5 compared growth rates of cows and suckling calves (cow-calf pairs) grazing NP alone with those grazing NP supplemented with different amounts of flax seed cake using the same procedures in Trial 4.

#### *2.1.3 Vetch and flax seed cake as supplements to native pasture grazing*

Trial 6 compared growth of weaned calves grazing NP alone with that of calves grazing NP supplemented with green vetch fodder, and vetch plus flax seed cake (FSC). Twenty weaned calves (12 male and 8 females) of the local Kandary and Sistani breeds and their crosses with Friesians ranging from 8–10 months of age with an average liveweight of  $73.6 \pm 12.27$  kg for the males and  $78.5 \pm 6.32$  kg for the females were used. They were divided into four groups of five (3 males and 2 females) based on age and liveweight, and the groups were randomly assigned to each of the treatments listed under in Table 1. Liveweight of the calves were estimated every 14 days using a measuring tape.

All the calves grazed native pastures from 05:00 – 09:00 hours in the morning, and from 15:00–18:00 hours in the afternoon each day. They supplements were fed

after grazing from 19:00-05:00 hours the next day in feeding troughs by trained women in the participating households. The vetch was harvested fresh, chopped by hand into 3-5 cm pieces and wilted for 24 hours before feeding. In Treatments 3 and 4, the chopped vetch was mixed with the FSC before feeding. Animals had free access to water.

#### *2.1.4 Statistical analyses*

All data were analyzed using the General Linear Models procedures. Data in Trials 4 and 5 were analyzed as a randomized block design using the sum of the initial weights of the cows and calves as covariate, and number of animals per treatment as replicates. Trial 6 data were analyzed as a 2 (sex) x 4 (treatments) factorial with 5 animal replications.

## 2.2 Results and achievements

### *2.2.1 Cotton seed cake*

Daily gain of cow-calf pair grazing NP supplemented with CSC was greater ( $P<0.05$ ) than those grazing NP alone (Table 3.5). Growth rates of those fed 3 kg or 4 kg CC daily did not differ ( $P>0.05$ ), but they were faster ( $P<0.05$ ) than those fed 2 kg.

### *2.2.2 Cotton seed cake*

Growth of cow-calf pair supplemented with FSC showed similar trends as that of CSC (Table 3.6).

### *2.2.3 Cotton seed cake*

Weaned calves grazing NP in addition with vetch or vetch and FSC grew faster ( $P<0.05$ ) than those grazing NP alone (Table 3.7). Grazing calves fed vetch alone and vetch with a kilo of FSC daily had similar ( $P>0.05$ ) growth rates, that were lower ( $P<0.05$ ) than those fed vetch plus 2 kg FSC.

## 2.3 Conclusions

In summer, supplementation of weaned calves grazing NP under village conditions in Baghlan Province with green forage legume fodder alone or with 1-2 kg FSC daily could increase growth rates. A daily supplementation of 2-3 kg CSC or FSC could increase growth rate of cow-calf pairs grazing NP.

### **Activity 3. Fodder chopper introduction and testing**

#### 3.1 Procedures

##### *3.1.1 Introduction and testing of hand-operated chopper*

A low-cost, hand-operated, fodder-chopper was introduced and compared with the farmers' practice of hand-chopping. Forty households were surveyed to know what they thought about the hand-chopping practice and the fodder-chopper.

##### *3.1.2 On-farm demonstration of the effect of chopping fodder on milk yield*

The effect of chopping on milk yield was demonstrated. Eighty milking cows in villages were divided into two groups of 40 cows. The groups were assigned to whole-maize (un-chopped, farmers' practice) or chopped (2-4 cm pieces) fresh maize fodder respectively, with a daily supplement of 2 kg cotton seed cake per cow for a 35-day period. Trained women recorded milk yield daily.

##### *3.1.3 Statistical analyses*

Milk yield data were analyzed as a randomized complete block using cows as replicates and initial milk yield of the individual cows as a covariate.

#### 3.2 Results and achievements

Households using the fodder-chopper spent less time on chopping fodder than those who chopped by hand (Fig. 3.1). The chopper also cut the fodder into smaller pieces than the farmers' method (2.5 vs. 14 cm, s.e = 0.67).

Cows fed chopped maize produced more milk ( $P < 0.05$ ) than those fed whole-maize (Fig. 3.2), possibly because they ate and digested more of the chopped than the un-chopped fodder.

#### 3.3 Conclusions

Farmers could cut-down workload by using the easy-to-use fodder chopper. Chopping fodder before feeding could increase milk yield.

### **Activity 4. Assisting farmers to survive 'feed shocks'**

#### 4.1 Procedures

Crop failures due to poor low rainfall and severe winters threatened livelihoods of some farmers during the project period. Therefore, the project purchased and

distributed forage legume hay, cotton and oil seed cakes to some farmer to reduce the risk of losing their animals due to poor winter feeding. Households were interviewed to for a feed back on the donation of feed supplements on their livelihoods.

#### 4.2 Results and achievements

More than 500 households benefited from the feed distribution (Fig. 3.3). Most household felt the feed saved their animals from starving to death.

#### 4.3 Conclusion

The feed donation assisted farmers to stand the shock of severe winter and crop failures.

### **3.3 Implications of results and achievements**

Best winter and summer feeding practices were demonstrated on-farm and disseminated through field days and farm visits to more than 500 households. Adoption of the strategies demonstrated could assist households to increase milk production and growth of their livestock in winter and summer. Increase in milk yield due to better feeding contributes to household food security by enabling mothers to feed more milk to their children, and sell the extra milk to improve household income. Time saved from using a hand-operated fodder chopper could be used on other income generating activities to improve household income. The recommended technologies have implications for support services such as the cotton and flax industries to produce more seed cakes. It will also mean good extension support to farmers to grow cotton and flax.

Table 3.1

Summary of winter and summer supplementation trials in Baghlan Province, north-west Afghanistan

Item	Winter Trials		
	1	2	3
	Cotton seed Cake (CSC) (kg/day/head)	Flax seed cake (FSC) (kg/day/head)	Legume hay and haulms (3 kg/head/day)
Treatment			
1	2 kg	2 kg	Alfalfa hay
2	3 kg	3 kg	Berseem hay
3	4 kg	4 kg	Mungbean haulms
Farms/households	10	10	10
Cattle breed	L, L x Friesian	L, L x Friesian	L, L x Friesian
Cow:calf/treatment	20	20	20
Mean cow age (yrs)	6.2.1±0.40	6.6±0.43	5.6±0.41
Mean calf age (yrs)	171.1±5.21	171.1±4.31	176.9±4.42
Mean cow weight (kg)	50.3±5.21	47.8±5.61	58.5±4.76
Average calf weight	5.9±0.42	5.9±0.42	5.9±0.42
Duration (days) <sup>1</sup>	93	93	74
	Summer Trials		
	4	5	6
	CSC (kg/day/head)	FSC (kg/day/head)	Natural pasture grazing (NPG) Fresh vetch (FV) and FSC
Treatments			
1	2 kg	2 kg	Natural pasture(NPG)
2	3 kg	3 kg	NPG + FV <sup>2</sup>
3	4 kg	4 kg	NPG + FV + 1 kg FSC <sup>3</sup>
4	Na	Na	NPG + FV + 2 kg FSC <sup>4</sup>
Farms/households	10	10	4
Cattle breed <sup>5</sup>	Local	Local	Local
Cow: calf/treatment	20	20	Na
Calves/treatment	Na	Na	5 (3 males, 2 females)
Mean cow age (yrs)	5.9±0.42	6.6±0.41	Na
Mean calf age (mons)	2-4	2-4	9.1±0.84
Mean cow weight (kg)	161.2±4.01	159.8±3.91	Na
Mean calf weight (kg)	37.7±4.31	37.7±2.21	75.6±10.13
Duration (days) <sup>6</sup>	62	62	42

<sup>1</sup>Duration= 15 December 2006 – 17 March 2007.<sup>2</sup>FV = Wilted vetch fodder fed at 6 kg/head/daily.<sup>3</sup>Flax seed cake fed at 1 kg/head/day.<sup>4</sup>Flax seed cake fed at 2 kg/head/day.<sup>5</sup>Local breeds = Kandary and Sastani.<sup>6</sup>Duration= 15 December 2006 – 26 February 2007.

Table 3.2

Milk off-take and daily gain of cow-calf pairs fed a basal diet of wheat straw supplemented with forage legume in winter under village conditions in Baghlan Province, north-west Afghanistan

Treatment	<sup>1</sup> Milk off-take (l/day)	Daily gain (g)
Wheat straw + berseem hay	5.9 a	262 a
Wheat straw + mung-bean hay	4.9 b	185 b
Wheat straw + alfalfa hay	4.3 b	256 a
s.e.	0.35	21.9

<sup>1</sup>Means in a column with different letters differ ( $P < 0.05$ ). Values are averages of 10 cow-calf pairs per treatment over a 72-day period.

Table 3.3

Milk off-take and daily gain of cow-calf pairs fed a basal diet of wheat straw supplemented with different amount of cotton seed cake in winter under village conditions in Baghlan Province, north-west Afghanistan

Treatments	<sup>1</sup> Milk off-take (l/day)	Daily gain (g)
Wheat straw + 2 kg CSC/day	4.1 b	271 b
Wheat straw + 3 kg CSC/day	4.9 a	294 a
Wheat straw + 4 kg CSC/day	4.6 a	369 a
s.e.	0.19	24.9

<sup>1</sup>Means in a column with different letters differ ( $P < 0.05$ ). Values are averages of 20 cows per treatment over a 72-day period.

Table 4

Daily milk off-take and daily gain of cow-calf pairs fed a basal diet of wheat straw in winter supplemented with different amount of cotton seed cake in winter under village conditions in Baghlan Province, north-west Afghanistan

Treatments	<sup>1</sup> Milk off-take (l/day)	Daily gain (g)
Wheat straw + 2 kg FSC/day	4.4 b	297 b
Wheat straw + 3 kg FSC/day	5.7 a	240 a
Wheat straw + 4 kg FSC/day	5.6 a	234 a
s.e.	0.28	16.9

<sup>1</sup>Means in a column with different letters differ ( $P < 0.05$ ). <sup>2</sup>Values are averages of 20 cows per treatment over a 60-day period.

Table 3.5

Daily gain of cow-calf pairs grazing native pastures supplemented with different amount of cotton seed cake (CSC) in summer under village conditions in Baghlan Province, north-west Afghanistan

Treatment	<sup>1</sup> Daily gain (g)
Natural pasture grazing only (NPG)	532 c
NPG + 2 kg CSC/head	714 b
NPG + 3 kg CSC/head	927 a
NPG + 4 kg CSC/head	953 a
s.e.	62.7

<sup>1</sup>Means in a column with different letters differ ( $P < 0.05$ ). Values are averages of 10 cow-pairs per treatment over a 60-day period.

Table 3.6

Daily gain of cow-calf pairs grazing native pastures supplemented with different amount of flax seed cake (FSC) in summer under village conditions in Baghlan Province, north-west Afghanistan

Treatment	<sup>2</sup> Daily gain (g)
Natural pasture grazing only (NPG)	675 c
NPG + 2 kg FSC/day	1101 b
NPG + 3 kg FSC/day	1400 a
NPG + 4 kg FSC/day	1497 a
s.e.	157.8

<sup>1</sup>Means in a column with different letters differ ( $P < 0.05$ ). Values are averages of 10 cow-pairs per treatment over a 60-day period.

Table 3.7

Daily gain of weaned calves grazing native pastures supplemented with wilted vetch and different amount of flax seed cake in summer under village conditions in Baghlan Province, north-west Afghanistan

Treatment	<sup>1</sup> Daily gain (g/day)
Natural pasture grazing only (NPG)	357 c
NPG + 6 kg fresh vetch fodder	458 b
NPG + 6 kg fresh vetch fodder + 1 kg FSC/day	464 b
NPG + 6 kg fresh vetch fodder + 2 kg FSC/day	537 a
s.e	45.9

<sup>1</sup>Means in a column with different letters differ ( $P < 0.05$ ). Values are averages of 5 weaned calves per treatment over a 45-day period.

Fig. 3.1. Time households use to chop fodder by hand and fodder-chopper, average of 40 households

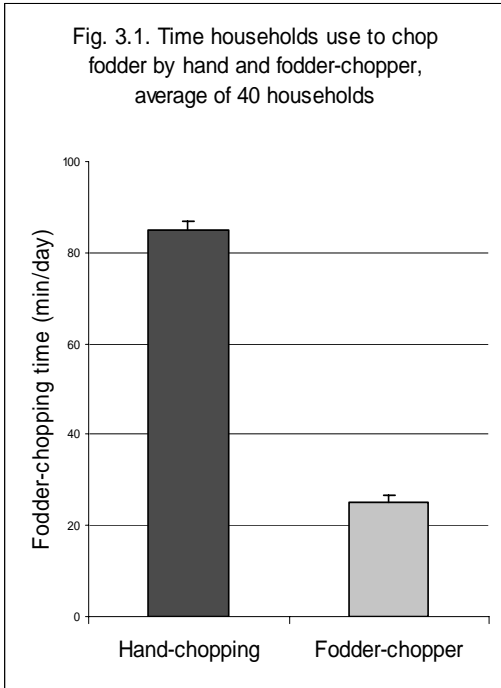


Fig. 3.2. Milk yield of cows fed whole and chopped mize fodder

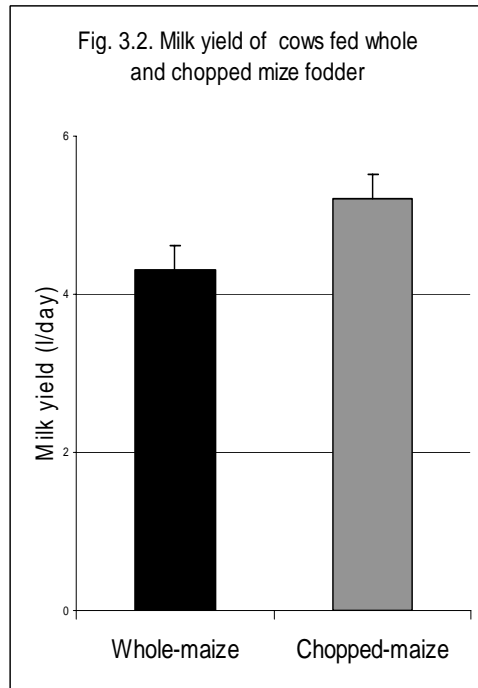
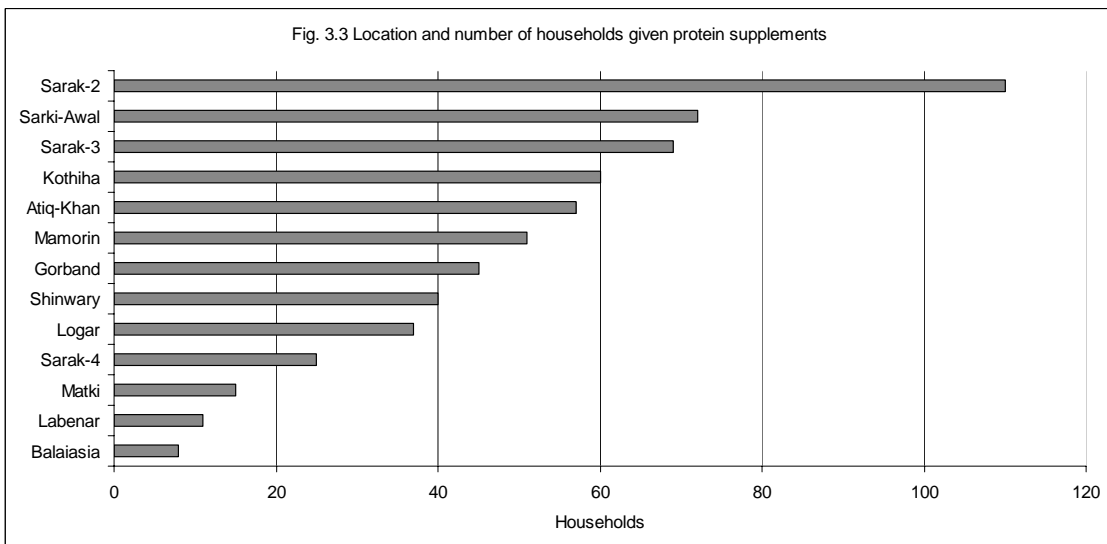


Fig. 3.3 Location and number of households given protein supplements



## **Output 4: Efficient household milk processing methods**

### **4.1 Background**

In Afghanistan, women care for cows and sucking calves. They milk cows, process and sell milk and milk products. They spend long hours in a day just to produce butter from yoghurt using local methods that only extracts about half of the butter from the yoghurt. Using the local churner puts a lot of stress on women; it results in dairy products with low quality, short shelf-life and low market value. Women processed manure for fuel by hand and boiled milk using manure as fuel. The smoke from the manure changes the flavor of the milk, and some women become infected from processing manure with their bare hands. Yet, they have limited opportunity to share their knowledge and experience.

The project worked with women in rural communities to create avenues for them to share their knowledge of good practices in milk production and processing. To ease the burden on women, and to improve the efficiency of household milk processing, constraints to household milk processing were identified and improved safe and faster methods of milk processing promoted.

### **4.2 Activities implemented**

#### **Activity 1. Empowering women to share knowledge on dairy production**

##### 1.1 Procedures

The women were assisted to form women interest groups (associations) and trained on better ways of caring for cows and calves, milking cows, processing milk, and documenting milk production and feed use. Four members of the women associations were offered further specialized training in milk processing at the ICARDA headquarters in Aleppo, Syria. Women Field Days were organized in partnership with the Ministry of Women Affairs in Baghlan Province.

##### 1.2 Results and achievements

By April 2008, association of livestock farmers made up of women from 600 households had been formed in 13 villages (see Fig. 1.1). These associations are being used as avenues to promote good practices in smallholder dairy production and processing as a means to improve household food security and incomes.

Women's field days, involving 500 Afghan women, were organized in four villages to enable the women to share knowledge and experience on good

practices (Fig. 4.1).

### 1.3 Conclusions

Associations made up of women in 600 households were formed in 13 villages. The associations were used for knowledge transfer and exchange on good practices for milk production and processing. Five hundred women attended women's field day organized in 2007. Four women were trained in milk processing outside Afghanistan.

## **Activity 2.** Promotion of safe and efficient household milk processing methods

### 2.1 Procedures

An easy-to-use, hand-operated, butter churner was introduced and trained women to operate it. The project donated churners and hand gloves to Women in 600 households. Gas cylinders were donated to 400 households. Women in 600 households were surveyed to know their opinion about the new butter churner.

### 2.2 Results and achievements

A survey of women in 600 households showed that they prefer the introduced churner to the local one because it cuts time for making butter from yoghurt (Fig.4.2.1). It also gives more butter from a unit weight of yoghurt than the local one (Fig. 4.2.2). Teenagers could easily operate the improved churner compared with the local one, thus reducing the workload of mothers.

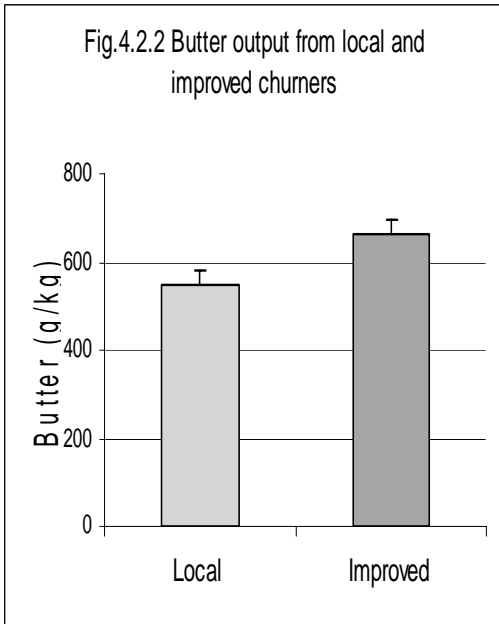
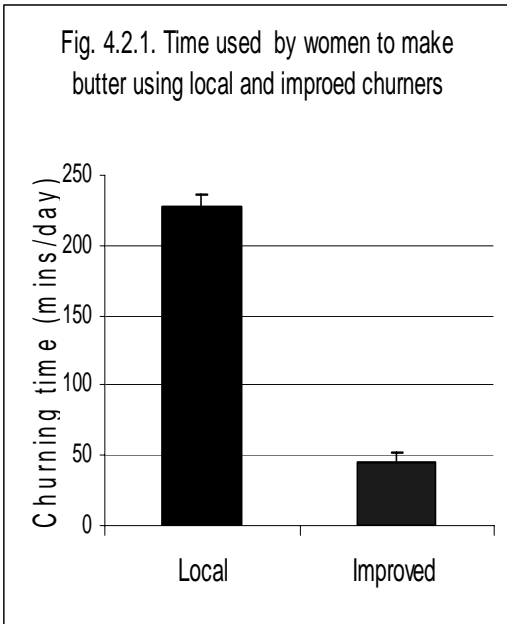
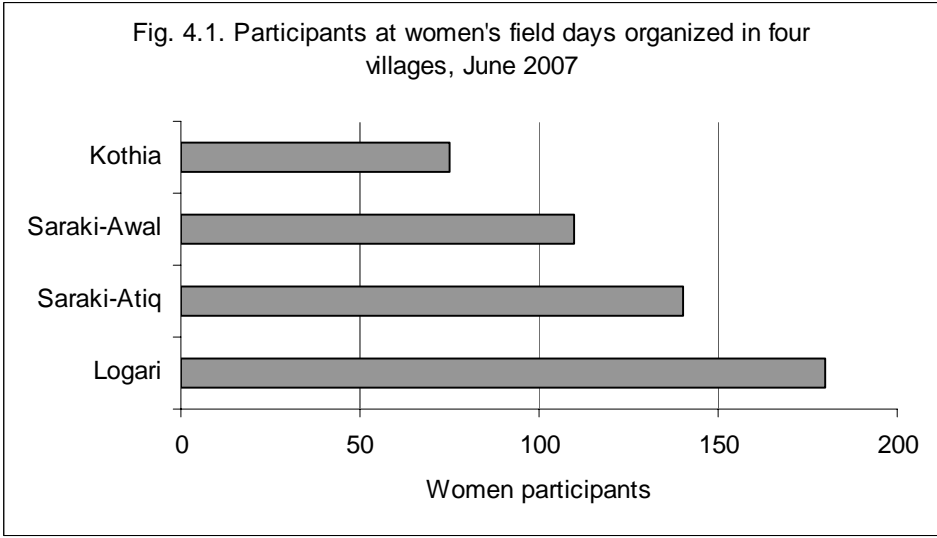
Most women surveyed said the gas cylinders and hand gloves improved milk flavor and reduced chances of contamination from manure. They also observed that the gloves reduced incidence of disease for women who used their bare hands for processing manure.

### 2.3 Conclusions

Easy-to-use and safe household milk processing methods were disseminated to 600 households. The improved methods reduced workload on women, and resulted in safe and better quality milk products with higher market value.

## **4.3 Implications of research results and achievements**

By promoting efficient milk processing methods that allow women to process more milk, and produce higher and better quality butter with less labor; the project is empowering women to adopt smallholder dairy production as an alternative livelihood to improve household food security and incomes.



## **Output 5: Strengthened capacity and improved knowledge transfer**

### **Activity 1. Strengthen capacity for research and development**

#### 1.1 Women

Since women play important roles in milk production, processing and marketing, special attention was given to empowering women to share knowledge and transfer technologies. Four women were employed as project assistants to generate income. They were trained in better ways of: caring for cows and calves, milking, processing milk, recording milk yield, and how to work with other women to spread the good practices. They sponsored for training in milk processing at the ICARDA Headquarters in Syria in March 2008. The project donated to the Ministry of Women Affairs to help with developing the computer skills of women. In May 2008, the project organized a short course on 'Forage and Livestock Production for Agricultural Students of Afghan Universities' for 32 including seven female students from 13 Afghan universities.

Women were encouraged to form Women Interest Groups (WIGs), and to organize individual and group discussions and Women Field Days to share knowledge on good practices for milk production and processing. They participated and made presentations at workshops organized by the project. In 2007, 505 women attended Women Field Days organized in four villages.

#### 5.2 Farmers

Field days and farm visits were organized to discuss technologies and to get a feed back from farmers on the technologies. The field days were attended by different stakeholders, including farmers community-level advisors, MAIL officials, local entrepreneurs, and NGO staff. Representatives of the associate.

#### 5.3 MAIL staff

MAIL staff attached to the project gained research experience from interaction with ICARDA staff. They were trained to conduct most of the routine monitoring of the project activities in 2<sup>nd</sup> and 3<sup>rd</sup> years. A staff of MAIL was sponsored by the project to participate in an international short-course on 'Integrated Crop-Livestock Production' organized by ICARDA, in Aleppo, Syria in May 2005.

Sayed Mahmood, national project coordinator, and Nezamudin Shams, assistant national project co-ordinator participated in an international short-course on 'Integrated Crop and Livestock Production' organized by ICARDA at Aleppo, Syria, in April, 2007. Mir Bashir, National Livestock Production Officer of FAO's

Dairy Project visit ICARDA, Aleppo, Syria for training in data management, and to draft a joint FAO-ICARDA extension booklet on fodder production in Afghanistan, in March 2008.

#### 5.4 Universities

Mr. Gul Aqa, then a student at Baghlan University and currently the Dean of Faculty of Agriculture at the same University was attachment to the Forage Group at ICARD Headquarters, Aleppo, Syria, for 14 days. The on-station experimental trials at the Poze-Eshun Research Station were used by the staff of the Faculty of Agriculture, Baghlan University to train undergraduate students in experimental or field plot design. Teachers and students of the universities of Baghlan, Balkh and Takhar attended the project field days to exchange knowledge. The project donated one desktop computer to the Faculty of Agriculture in Baghlan University to assist with building the computer skills of students.

The project organized the first training course on 'Forage and Livestock Production for Agricultural Students of Afghan Universities' for 32 students, including seven female students from 13 Afghan universities (Kapisa, Baghlan, Balkh, Bamyan, Faryab, Herat, Helmand, Kabul, Khost, Nangarhar, Paktia, Kunduz, Takhar) on 19-22 May at Puli-Khumri, Baghlan Province. Resource persons were from ICARDA and FAO.

#### 5.5 NGOs

In May 2005, two staff of AKDF, Rameh Rahman and another staff were sponsored by the project to attend an international short-course on 'Integrated Crop-Livestock Production' organized by ICARDA in Aleppo, Syria.

### **Activity 2. Disseminate knowledge and information**

#### 2.1 Publications

- 1 Larbi A, Nezamuddin S, Mahmood S, Najubullah M and Amegbeto K (2008). Farmer-participatory evaluation of summer feeding strategies in Afghanistan: growth of cow-calf pairs grazing native pasture supplemented with oil-seed cakes. In: *Multifunctional Grasslands in a Changing World, Volume II/Edited by Organizing Committee of IGC/IRC Congress. XXI International Grassland Congress/VIII International Rangeland Congress, Hohhot, China, pp. 208.*
- 2 Larbi A., Mahmood S., Nezamuddin S., Najibullah M., Manan A., and Rizvi J. (2008). Alfalfa cultivar and agronomic practices affect fodder yield in Afghanistan. A poster to presented at the *Joint Annual Meeting of Soil Science Society of America, American Society of Agronomy, and Crop Science Society of America in Houston, Texas, 5-9 October, 2008.*

- 3 Larbi A., Mahmood S., Nezamuddin S., Najibullah M., Manan A., and Rizvi J. (2008) Cowpeas for fodder and grain production in Afghanistan. A poster to be presented at the *Joint Annual Meeting of Soil Science Society of America, American Society of Agronomy, and Crop Science Society of America in Houston, Texas, 5-9 October, 2008.*
- 4 Larbi A., Mahmood S., Nezamuddin S., Najibullah M., Manan A., and Rizvi J. (2008). Vetches and grasspea for hay, straw and grain production in Afghanistan. Poster to be presented at the *Joint Annual Meeting of Soil Science Society of America, American Society of Agronomy, and Crop Science Society of America in Houston, Texas, 5-9 October, 2008.*

## 2.2 Posters and extension materials

Eight posters were developed. They are translated to the local dialects.

## 2.3 Workshops

An end of project workshop was organized in October 2007 to share the results of the project with policy makers. The workshop was attended by representatives of all stakeholders including representative of the farmers associations, universities, DFID, AKDF, FAO, an adviser to the Minister of Agriculture, and the Deputy Minister of Agriculture. The project was judged the best among the 11 RALF projects based on the research and development achievements. The MAIL officials showed interest in replicating the project in other provinces. Recommendations were made to government advisors to propose a policy environment that enables communities to implement the income generating, alternative technologies that were tested and verified by the project.

## 5.4 Implications of results and achievements

Empowering women to form interest groups for sharing knowledge and experiences meant helping them to adopt smallholder dairy production as an alternative livelihood to improve household food security and incomes. Strengthening the capacity of partners for research-and-development ensured the long-term sustainability of the improvements, particularly with respect to proposed new policies and strategies

## **Activity 6: An assessment of project impacts on livelihoods**

### **Activity 6.1: Impact assessment procedures**

Monitoring to assess the progress of the project and potential impact on livelihoods was built into the implementation of activities to achieve outputs 1-5. This provided both qualitative and quantitative data for assessing the impact of the project activities on household income, food security and wellbeing. Two approaches were used to assess the impact of the project activities on livelihoods. The first approach was through feed back from the participating households about the project activities and/or technologies during farmer participatory workshops, field visits, field days, and exchange visits. The second was based on quantitative data generated during the implementation of the project activities at the village level. In both cases, data was collected by both men and women trained to collect data.

Key indicators used included changes in:

- Household labor use in forage and milk production.
- Land area used in forage production.
- Milk output and growth rates of cattle,
- Institutional capacity - MAIL, AKDN, Universities, farmers' interest groups.

### **2. Activity 6. 2. Project impacts**

1. Farmers' associations consisting of men and women in 600 households were established in 13 villages. The associations strengthened collective action, reduced transactions costs involved in dairy processing and also provided a forum through which problems affecting the rural communities were discussed and solutions offered.
2. Six hundred households were directly linked to high-value agricultural markets through smallholder dairy production. About 1500 households benefited indirectly through participation in field days, farm visits, workshops and other project related activities, thus making a total of nearly 2100 households. Adoption of improved dairy production could increase income and improve the well being of these households.
3. Women who are responsible for dairy production in the 600 participating households were empowered through women field days, training and acquisition of new skills in dairy cattle feeding and dairy processing which improved their income-earning capacity.
4. On-farm fodder production increased by 15-25% through demonstration of best agronomic practices. The project identified high-yielding varieties of various feed legume crop species. Adoption of the high-yielding varieties is expected to increase fodder production by more than 20%.

The increase in fodder yield could improve livestock feeding and result in higher milk off-take for household consumption. Integrating the legumes into the cropping system could increase soil nitrogen and phosphorus level by 10-15%, provide quality feed, and reduce the grazing pressure on rangelands.

5. The best feeding practices demonstrated by the project increased milk off-take by more than 15%, thereby improving household nutrition. The high quality protein and micro-nutrients in milk would relieve protein malnutrition and micro-nutrient deficiency in the most vulnerable household members – malnourished children and child-bearing women. Sale of excess milk and milk products improved household income.
6. The introduction of less labor demanding methods of milk processing eased the burden on women who are responsible for such work. For example, the improved churner introduced by the project reduced the time women used in butter-making by more than 50%, thereby leaving them with more time for child rearing and social activities. Similarly, the hand-operated machine reduced time used for chopping fodder by more than 75% leaving more time for other livelihood improvement activities.
7. The project and associated activities created a viable smallholder dairy industry with employment generating multiplier effects. Women were employed as project staff thereby generating income for their households.
8. The multi-stakeholder partnerships established for the implementation of the project enhanced collaboration between ICARDA, community-based organizations, the national partners and development agencies.
9. Participatory approaches and methods were developed for better targeting of smallholder dairy production and processing technologies to improve adoption.
10. The institutional capacity of MAIL, Afghan Universities and AKDF in development activities related to the design, implementation and evaluation of dairy production and processing technologies and strategies was enhanced through participation in workshops, local and international short-term courses and on-the-job training.

