Afghanistan Water, Agriculture, and Technology Transfer (AWATT) Program

Forage Technology Transfer Program
Final Technical Report

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<td>Afghanistan Water, Agriculture and Technology Transfer</td>
</tr>
<tr>
<td>Canal</td>
<td>In this and all AWATT documents, the word “canal” refers to either a secondary or tertiary canal. ¹</td>
</tr>
<tr>
<td>CSU</td>
<td>Colorado State University</td>
</tr>
<tr>
<td>jerib</td>
<td>Unit of land area approx. 0.2 hectare</td>
</tr>
<tr>
<td>MAIL</td>
<td>Ministry of Agriculture, Irrigation and Livestock</td>
</tr>
<tr>
<td>MEW</td>
<td>Ministry of Energy and Water</td>
</tr>
<tr>
<td>NMSU</td>
<td>New Mexico State University</td>
</tr>
<tr>
<td>NVDA</td>
<td>Nangarhar Valley Development Authority</td>
</tr>
<tr>
<td>SIUC</td>
<td>Southern Illinois University Carbondale</td>
</tr>
<tr>
<td>UIUC</td>
<td>University of Illinois at Urbana-Champaign</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
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</table>

¹ This distinction is important because the new Afghan Water Law passed this year (2010) gives responsibility for primary canals (diverted directly from the rivers) to the Ministry of Energy and Water (MEW), and for secondary canals (diverted from the primary canals to villages) and tertiary canals (diverted from the secondary canals for distribution to the farms) to be the responsibility of MAIL, specifically the newly established MAIL Department of Irrigation (DI). Similarly, the term “watercourse” is used interchangeably with the word “canal” in AWATT documents.
EXECUTIVE SUMMARY

The Afghanistan agricultural system consists of irrigated, rain fed and rangeland areas to meet their agricultural production. In the first two categories, Afghan farmers concentrate on their cereal production, mainly wheat and rice; while in the upper rangeland watershed areas they concentrate on their livestock production, especially sheep and goats. Resulting from the lack of legume and nutritional forage crops in the lower watershed farming system, where animals feed on low quality straw; the livestock, milk and meat production have declined. In addition, the soils under the improper wheat/rice rotation have deteriorated due to the lack of forage legume in the crop rotation. Moreover, the upper rangeland watershed conditions have deteriorated due to overgrazing and lack of alternative forage resources in the lower watershed farming system. In addition, the majority of Afghan farmers has lack of knowledge of the basic principles of agricultural production, water management, low-cost agronomic, and forage production technologies beneficial to farmers, and their families in terms of increasing their income and efficiency in their use of time or labor. Lack of high quality forage crops, improper wheat/rice rotation, extension forage technology together with the low skills of extension workers have negatively impacted the livestock and soil productivity in Afghanistan.

Implementing an integrated crop-livestock production system is critical for the development of the agricultural sector and overall economy of Afghanistan. Increasing the capacity to achieve self-sufficiency in forage and seed production is the key to the sustainability and growth of the agricultural sector in Afghanistan. And the introduction and development of improved forage crops provide many economic opportunities for Afghan farmers to improve their livelihoods and increase their profits, compared to the production of traditionally-planted forage crops and traditional farming systems and techniques used for generations.

Integrated crop-livestock production is critical for the development of Afghanistan's agricultural sector. The forage Technology Transfer program was a significant part of AWATT's integrated watershed management program because, in order to establish trees and woody shrubs on the hillsides, livestock must be excluded from these upland areas for extended periods of time. To accomplish this, animals must be confined to farmlands in the lower watersheds and alternate sources of feed must be developed. Livestock feed can be expensive, difficult to obtain, and the protein content of many forages is insufficient for acceptable levels of animal production.

One of the major components and goals of the AWATT's forage Technology Transfer Program is the development of cost-effective, sustainable, high quality forages and the production of seed necessary for the continued propagation of these crops in Afghanistan. During the period 2009-2011, the AWATT Forage Technology Transfer Program initiated and established many different activities to achieve this goal and build a capacity for production of forage and good quality seed, of improved varieties, in Afghanistan.

The purpose of this final forage technical report is to provide an overview of these activities and to present the significant accomplishments of the AWATT Forage Technology Transfer Program, as a part of the AWATT Program, to the development of Afghanistan agricultural sector and in particular to the forage and seed production development.
INTRODUCTION

The AWATT Forage Technology Transfer Program was introduced, in May of 2009, in five districts of Balkh province: Dehdadi, Balkh, Nahr-e-Shahi, Khulm and Chemtal.

In 2009, under the leadership of the AWATT Forage and Rangeland Specialist, Dr. Hamdy Oushy, the AWATT Forage Technology Transfer Program activities were developed in Balkh Province. During the 2009 growing season, the AWATT Forage program, in collaboration with the MAIL and DAIL research and extension systems, established 29 forage demonstration plots, 3 pearl millet foundation seed production sites, and 3 forage applied research trials at MAIL Dehdadi Agricultural Research Station and the Agronomic Research Farm at the College of Agriculture, Balkh University.

In 2010, the AWATT Forage Technology Transfer Program activities were expanded and developed in seven provinces in Afghanistan: Herat, Balkh, Parwan, Nangarhar, Kabul, Logar and Wardak. During the 2010 growing season, the AWATT Forage program established 518 forage demonstration plots, 7 seed production sites and 19 forage applied research trials in collaboration with the MAIL and DAIL research and extension systems; in addition to the College of Agricultures at Kabul, Balkh and Herat Universities including:

- 74 forage demo plots, 3 seed production sites and 10 research trials in Herat province;
- 141 forage demo plots, 1 seed production site and 2 research trials in Balkh province;
- 13 demo plots, 3 seed production sites and 7 research trials in Kabul province;
- 250 forage demo plots in Parwan province;
- 20 forage demo plots in Nangarhar province;
- 10 demo plots in Logar province;
- 10 demo plots in Wardak province.

The major objectives of the AWATT Forage Program were to improve traditional forage crops available for livestock production by introducing different varieties better-adapted to the Afghan farmers’ needs and local conditions; to ensure the sustainability of the transferred forage technology by establishing the research and on-farm demonstration activities, developing forage foundation seed production sites; to demonstrate the benefits from using newly introduced open pollinated forage and improved seeds from Egypt to Afghan farmers, and to build capacity among farmers, MAIL extension workers and researchers, faculty members, teachers, and students of the Universities and Vocational Schools in selected provinces in Afghanistan.
The AWATT Forage Technology Transfer Program Fact Sheet Information

During the period 2009-2011, the AWATT Forage Technology Transfer Program initiated and established many different activities and achieved many significant accomplishments to forage and seed production development in Afghanistan that can be summarized as follows:

- 22 forage irrigation, forage crop varietal comparison experiments and nitrogen fertilizer trials were applied in Balkh, Herat, and Kabul provinces.
- 547 forage demonstration plots were established in seven provinces in Afghanistan: Balkh, Herat, Kabul, Nangarhar, Parwan, Wardak and Logar provinces.
- 10 forage foundation seed production sites were established in three provinces in Afghanistan: Balkh, Kabul and Herat provinces.
- 172 acres, of farmer owned lands, have been cultivated and demonstrated by pearl millet (Shandawel-1 open pollinated variety), Sudan grass (Giza-1 variety) and forage Cowpea (Cream-1 variety) as new forage varieties introduced from Egypt by Dr. Hamdy Oushy, to MAIL and the Afghan farmers, as the main summer forage crop.
- About 17,560 farmers, extension workers, faculty members, students and teachers have participated and trained in more than 579 demonstration plots, foundation seed production, and applied research trials, at their farms, MAIL and DAIL’s Research Stations and College Farms, on the establishment of improved seed production technologies, to build farmer’s capacity in forage crop and seed production.
• 60.1 tons of Urea and DAP and 1,200 kg of pearl millet, cowpea and Sudangrass seeds were provided by AWATT Forage Program to the 547 farmers in order to fertilize, plant and test the newly introduced forage crops at their owned lands-demo plots, and for future seed multiplication.

• 329 MAIL extension workers in seven provinces, listed above, received adequate training in forage production and seed production; including a large number of MAIL researchers who have received specialized training in forage applied research at MAIL Dehdadi, Shishem Bagh, Badam Bagh and Herat Agricultural Research Stations.

• 2.6 Metric Tons of pearl millet, cowpea and Sudangrass foundation seed have been produced with cooperation between MAIL and AWATT at MAIL’s Lands in Kabul, Herat, and Balkh provinces in 2009 - 2010.

• 1.4 Metric Tons of pearl millet, cowpea and Sudangrass foundation seeds delivered to MAIL in June 2011 in order to produce the certified seeds of these improved forage varieties through local private seed enterprises and/or MAIL Seed System.

• 1.2 Metric Tons of pearl millet, cowpea and Sudangrass foundation seeds used by Afghan farmers in 566 forage demonstration plots in seven provinces.

• Capacity building in seed production of forage Pearl millet, Sudangrass and Cowpea, have been developed at the seed production sites at MAIL and DAILs Research Stations in Balkh, Herat, and Kabul provinces to produce, and maintain good quality and health standards for the starter seed materials of newly introduced improved forage varieties.

**AWATT Forage Technology Transfer Program Activities in 2009 and 2010**

**Forage Extension**

The main objectives of AWATT Forage Extension activities are:

• To demonstrate and evaluate the proved forage technologies at the farmers’ levels;

• To Improve the capacity of farmers via demo plots;

• To improve the capacity of DAILs’ extension workers, researchers, and faculty members through lectures, hands-on training and field days.

547 forage demonstration plots were established at farmer-owned lands, MAIL and DAIL’s Research Stations and Universities’ Agronomic Research Farms in seven provinces in Afghanistan including Balkh, Herat, Kabul, Nangarhar, Parwan, Wardak and Logar provinces; 172 acres of the farmer-owned land have been cultivated and demonstrated by pearl millet - a forage crop that was recently introduced by AWATT’s forage program to the Afghan farmers. Approximately 2.6 Metric Tons of pearl millet, cowpea and Sudangrass foundation seed were produced in collaboration with MAIL and AWATT in MAIL Lands in Kabul, Herat, and Balkh provinces in 2009-2010.
Balkh Province

On Farm Demonstration Activities in 2009

In 2009, under the leadership of Dr. Hamdy Oushy, the AWATT Forage and Rangeland Specialist, the AWATT Forage Technology Transfer Program introduced two new promising forage summer crops – forage pearl millet and sorghum/Sudangrass hybrid. These two forage crops were used for feeding the farmers’ household livestock and sold by farmers as a cash crop. It was expected that pearl millet would do well as a cash forage crop as there was a limited supply of forage sold in the Mazar-e-Sharif market (primarily alfalfa). The farmers’ response to alternative forage crops (especially with the Kuchi people who have landholdings) has been very positive.

In June 2009, the AWATT Forage Technology Transfer Program, on-farm demonstration activities, was initiated and established in five districts in Balkh Province in Afghanistan including Dehdadi, Chemtal, Nahr-e-Shahi, Khulm, and Balkh and at Dehdadi MAIL Agricultural Research Station.

In 2009, the AWATT Forage Program tested and evaluated the introduced forage pearl millet (Shandawel-1 variety from Egypt) in comparison with Sorghum/Sudangrass hybrid (Mabrouk variety from Egypt) and local yellow corn (Jawari) at two levels: 1) Farmers’ level and 2) MAIL Dehdadi Research Station and Agronomic Research Farm of Balkh University level. Twenty nine forage on-farm demonstration plots at farmer-owned land were established in 600.00 m2 plot areas, by the AWATT Forage program, in the summer growing season of 2009, to test and evaluate the yield performance of the introduced pearl millet in comparison with the sorghum/Sudangrass hybrid and local forage Jawari (Yellow corn) at the farmer’s level in collaboration with MAIL in five districts: Dehdadi, Chemtal, Nahr-e-Shahi, Khulm, and Balkh in Balkh Province.

The AWATT Forage Program provided gratis the following agricultural materials for every forage crop on farm demo plots:

- 50 kg of chemical fertilizer (UREA 46% N);
- 50 kg of chemical fertilizer (DAP-Phosphorous);
- Seeds of forage Pearl millet, sorghum/Sudangrass hybrid, and local Jawari (Yellow corn);
- Training and technical assistance.
- Follow up, monitoring and guideline through several field visits and field days.
Fertilizer distribution to farmers in Chemtal and Dehdadi districts, Balkh province in June 2009.

Farmers were encouraged and trained to apply animal manure to AWATT forage demo plots in Balkh district, Balkh Province in June 2009.

The AWATT Forage Technology Transfer Program has built significant public awareness among forage stakeholders in Balkh Province. For instance, the AWATT Forage Program contacted the largest livestock producers in Balkh District - the Kuchi farmers. These farmers were encouraged to be involved in the AWATT Forage Program Activities in Balkh Province 2009-2010 in order to secure their summer needs of fresh forage for their animal in the lower watershed irrigated areas and reduce the pressure of overgrazing in the rangeland upper watershed areas. Therefore, three forage demo plots were established on Kuchi farmers’ land in Balkh district in June 2009.

Several meetings were held at the village level in five Districts of Balkh Province to introduce the AWATT Forage Technology Transfer Program to farmer’s leaders and villagers. In addition, a group of collaborative local leaders including Kuchi, farmers, and other influential community members were selected as close allies for the AWATT Forage Program implementation in Balkh Province. A working relationship between the AWATT Forage Program and the ASAP Program in Balkh Province was established on forage technology.
Local farmers have also been engaged in advising and in actively participating in demonstrating the crops and technologies introduced by the AWATT Forage Program.

The AWATT Forage Program Leader Dr. Oushy in regular technical meetings with Extension & Research Team at AWATT Headquarter in Mazar-e-Sharif City in Balkh Province

**Pearl Millet Forage Production in 2009**

In the growing season of 2009, the collected data from pearl millet and sorghum/Sudangrass hybrid multiple cuts were computerized for a future analysis of yield performance. Collected forage data were evaluated at 29 farms in Dehdadi, Chemtal, Nahr-e-Shahi, Khulm, and Balkh districts in Balkh Province. The obtained results indicated that pearl millet can produce a good yield of high quality dry matter. Pearl millet yielded between 20 to 25 tons of fresh forage per *jerib* (2000 m²) per growing season in Afghanistan.

The yield results obtained from 5 farms in Nahr-e-Shahi District in the summer of 2009 and displayed below in Table (1) and Figure (1) showed that pearl millet yield ranged between 58.8 – 150.2 tons per *hectare* and Sorghum/Sudangrass hybrid yield ranged between 70.1 – 137.8 tons per *hectare* from only three cuts.

These results indicated that the pearl millet and Sorghum/Sudangrass can yield up to 30 tons of fresh forage per *jerib* from only three cuts. Since, Sorghum/Sudangrass hybrid has been used in these trials as a performance comparison to pearl millet and Jawari; the Sorghum/Sudan grass hybrid will not be considered as a recommended newly introduced high yielding forage crop for Afghanistan. This is partially because this forage crop is a hybrid, and farmers cannot produce their own seeds and farmers also cannot afford its price.
Table 1. Total fresh forage yield (ton/ha) of 5 demonstration plots and the combined yield of three tested forage crops obtained from three cuts at Nahr-e-Shahi District, Balkh Province in the summer growing season of 2009.

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>Farmer#1 Abdul Raziq</th>
<th>Farmer#2 Amruddin Ghulam</th>
<th>Farmer#3 Abdul Bashir Ahmad</th>
<th>Farmer#4 Abdul Ghafar Khan</th>
<th>Farmer#5 Nasir Ahmad</th>
<th>Combined Analysis Average Fresh Forage Yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Fresh Forage Yield (ton/ha)</td>
<td>Total Fresh Forage Yield (ton/ha)</td>
<td>Total Fresh Forage Yield (ton/ha)</td>
<td>Total Fresh Forage Yield (ton/ha)</td>
<td>Total Fresh Forage Yield (ton/ha)</td>
<td></td>
</tr>
<tr>
<td>Pearl Millet</td>
<td>58.76 A</td>
<td>102.25 A</td>
<td>150.24 A</td>
<td>104.72 A</td>
<td>140.26 A</td>
<td>111.57 A</td>
</tr>
<tr>
<td>Sorghum/Sudan grass hybrid</td>
<td>70.13 A</td>
<td>109.49 A</td>
<td>137.76 A</td>
<td>101.34 A</td>
<td>119.75 B</td>
<td>108.03 A</td>
</tr>
<tr>
<td>Yellow Corn (Jawari)</td>
<td>38.99 B</td>
<td>48.75 B</td>
<td>51.00 B</td>
<td>62.00 B</td>
<td>51.99 C</td>
<td>49.94 B</td>
</tr>
<tr>
<td>CV (%):</td>
<td>16.31</td>
<td>5.99</td>
<td>14.94</td>
<td>11.59</td>
<td>6.66</td>
<td>20.49</td>
</tr>
<tr>
<td>LSD (0.05):</td>
<td>15.79</td>
<td>8.99</td>
<td>29.21</td>
<td>23.48</td>
<td>11.98</td>
<td>12.11</td>
</tr>
</tbody>
</table>

Figure 1. Average of total fresh forage yield (ton/ha) of the tested three forage crops obtained from three cuts at 5 demonstration plots in Nahr-e-Shahi District, Balkh Province in the summer growing season of 2009.

On Farm Demonstration Activities in 2010

Testing and evaluation process of the introduced forage pearl millet

In 2010, based on the promising results obtained in 2009, the AWATT Forage Program continued to test and evaluate the introduced forage pearl millet (Shandawel-1 variety). In the summer growing season of 2010, 141 forage on-farm demonstration plots were established to test and demonstrate pearl millet at farmer-owned land in 600 m² plots by the AWATT Forage program in 14 districts in Balkh province: Balkh, Char Bolak, Chemtal, Dehdadi, Shortepa, Kaldar, Sholgara, Nahr-e-Shahi, Khulm, Marmul, Dawlatabad, Zareh, Charkent, and Keshendi (see map below).
AWATT Forage Technology Transfer Program Final Technical Report

AWATT Forage Technology Transfer Program extended its Activities over 14 Districts in Balkh Province in 2010

These testing and demonstrating activities can be summarized as follows:

- One hundred forty one forage demonstration plots have been implemented in the 14 districts, where 10 demonstration plots were established in each district in Balkh Province, 10.3 hectares of farmer owned land were cultivated with pearl millet for forage and seed production;

- The AWATT forage team had been working closely with the USAID and the MAIL Agricultural Extension Department; in addition to held meetings and field visits with USAID representatives in Balkh province to discuss and demonstrate the progress on the AWATT Forage Program activities. Moreover, the AWATT forage team participated in all the MAIL extension departmental meetings about Pearl millet establishment and development program, exchange ideas, and share their knowledge with MAIL extension agents.

AWATT Forage Team Joined the USAID-Audit Team in field visits to forage demo plots in Balkh province, 2010.
The AWATT Forage Program team attended several meetings with the Balkh district administration to provide information about the program and the progress that was made. The AWATT program had received the full support of the Balkh district administration to continue the pearl millet foundation seed program, forage establishment and development program for the next year in order to alleviate livestock feeding problems for local farmers.

The AWATT Forage team in contacts with forage stakeholders in Balkh to introduce the forage pearl millet establishment and development program

The AWATT team with DAIL extension workers visited every farmer separately to evaluate the effect of pearl millet forage on their livestock and income. In addition, 14.5 tons of Urea and DAP and 200 kg of pearl millet seeds were provided by the AWATT Program to 141 farmers in order to establish their forage demo plots and produce their own pearl millet seeds for the next year of planting. The farmers paid 25% of the fertilizer costs, as a sign of ownership, and carried out all the agricultural practices in their own at their farms.

AWATT team visited every farm of the 141 farms separately to evaluate, follow up, guide farmers and see the effect of pearl millet forage on their livestock production and household incomes.
Farmers readily accepted the introduction of pearl millet and described it as the best forage crop, pointing to its high resistance to lodging (stalk breakage above ground level), multiple cutting (4-5 cuts), high nutritional value in which their milk production was significantly increased as well as their animals’ weight gain. Farmers expressed their willingness to replace the local Jawari (Yellow corn) with pearl millet.

Demonstration and testing of the pearl millet productivity, crop management and the feeding system for milking cows was established at the Kefayat Dairy Cattle Farm, Mazar-e-Sharif in Balkh district in one large-scale (10 jeribs – 2 hectares) forage demo plot.

Pearl Millet Forage Yield Performance Results

The AWATT Forage Program team prepared layouts of 140 demonstration plots in 14 districts and one large scale forage demonstration plot at the Kefayat Dairy Cattle Farm in Mazar-e-Sharif. Forage data from four cuts at the farmers' demo plots and five cuts at the Kefayat Dairy Cattle Farm demo plots were collected by the MAIL extension workers and AWATT Forage team. The data analyzed for a future evaluation of yield performance on farmer-owned land.

The forage pearl millet yield results obtained in 2010 at 133 demonstration plots (farms) in Balkh province are displayed below in Table (2) and Figure (2).

Table 2. Average fresh forage yield of pearl millet obtained in 14 Districts in Balkh Province at 133 demonstration plots (farms) in the summer growing season of 2010

<table>
<thead>
<tr>
<th>SN</th>
<th>District Name</th>
<th>Number of Farmers</th>
<th>Average Fresh Forage Yield per Cut (MTon/ha)</th>
<th>Total Fresh Forage Yield (MTon/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cut - 1</td>
<td>Cut - 2</td>
</tr>
<tr>
<td>1</td>
<td>Balkh</td>
<td>7</td>
<td>46.31</td>
<td>35.43</td>
</tr>
<tr>
<td>2</td>
<td>Char Bolack</td>
<td>9</td>
<td>43.13</td>
<td>44.76</td>
</tr>
<tr>
<td>3</td>
<td>Char Kent</td>
<td>10</td>
<td>38.15</td>
<td>38.94</td>
</tr>
<tr>
<td>4</td>
<td>Chemtal</td>
<td>10</td>
<td>37.68</td>
<td>41.90</td>
</tr>
<tr>
<td>5</td>
<td>Dawlat Abad</td>
<td>9</td>
<td>43.80</td>
<td>39.54</td>
</tr>
<tr>
<td>6</td>
<td>Dehdadi</td>
<td>9</td>
<td>41.11</td>
<td>39.19</td>
</tr>
<tr>
<td>7</td>
<td>Kaldar</td>
<td>9</td>
<td>38.43</td>
<td>39.15</td>
</tr>
<tr>
<td>8</td>
<td>Khulm</td>
<td>10</td>
<td>34.66</td>
<td>38.53</td>
</tr>
<tr>
<td>9</td>
<td>Kishindi</td>
<td>10</td>
<td>45.32</td>
<td>45.79</td>
</tr>
<tr>
<td>10</td>
<td>Marmul</td>
<td>10</td>
<td>38.83</td>
<td>38.52</td>
</tr>
<tr>
<td>11</td>
<td>Nahr-e-Shahi</td>
<td>10</td>
<td>40.82</td>
<td>43.96</td>
</tr>
<tr>
<td>12</td>
<td>Shortapa</td>
<td>10</td>
<td>47.04</td>
<td>46.26</td>
</tr>
<tr>
<td>13</td>
<td>Shoulgara</td>
<td>10</td>
<td>37.74</td>
<td>39.84</td>
</tr>
<tr>
<td>14</td>
<td>Zari</td>
<td>10</td>
<td>38.88</td>
<td>36.46</td>
</tr>
<tr>
<td></td>
<td>Average of Fresh Forage Yield (MTon/ha)</td>
<td>14</td>
<td>133</td>
<td>40.85</td>
</tr>
</tbody>
</table>

Note: The missing farmers in the table were faced shortages in water irrigation in which we could not obtain viable data.
Figure 2. Average of fresh forage yield (MTon/ha) of pearl millet obtained from four cuts at 133 demonstration plots in 14 Districts in Balkh Province in the summer growing season of 2010

The forage pearl millet yield results obtained in 2010 at the Kefayat Dairy Cattle Farm in Mazar-e-Sharif demonstration plot are displayed below in Table (3) and Figure (3).

Table 3. Fresh forage yield of pearl millet obtained from 5 cuts at the Kefayat Dairy Cattle Farm demo plot in Balkh Province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>Farmer Name</th>
<th>Crop</th>
<th>Village Mazar-e-Sharif City</th>
<th>Fresh Forage Yield per Cut (MTon/ha)</th>
<th>Total Fresh Forage Yield (MTon/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdul Salam Khan</td>
<td>Pearl Millet</td>
<td>Kefayat Dairy Cattle Farm</td>
<td>Cut - 1</td>
<td>Cut - 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>41.75</td>
<td>40.08</td>
</tr>
</tbody>
</table>

Figure 3. Average of fresh forage yield (MTon/ha) of pearl millet obtained from five cuts at Kefayat Dairy Cattle Farm demo plot in Balkh Province in the summer growing season of 2010
Summary of results

- The forage pearl millet yield ranged from 4-5 cuts per summer growing season.
- The pearl millet fresh yield ranged from 136.8 – 170.7 MTon/ha per growing season.
- The overall average fresh forage yield of pearl millet over 14 districts for cut 1, 2, 3, 4 were 40.9, 40.6, 38.8, 32.9 MTon/ha per growing season of 2010.
- In comparison with the only local existing traditional summer forage crop Jawari (local yellow corn), pearl millet proved its superiority over Jawari and produced three times as much fresh yield (153.1 MTon/ha) as Jawari (50 MTon/ha per season).
- The participating 141 farmers reported that they will replace Jawari with pearl millet after they planted at their farms, tested, fed to their livestock, and increased milk production and the weight gain of their livestock.
- The participating 141 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers and make it available in their local seed markets; in addition, they expressed their willingness to purchase and pay for the improved pearl millet seed for 100/Afs per Kg.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, high nutritional, drought resistance and long growing season forage pearl millet crop be registered and certified at MAIL Seed System as a new summer forage crop for the benefits of the Afghan farmers, herders, dairy productions and for agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the one of the first forage crops to be produced according to the new seed law of Afghanistan.
Herat Province

On Farm Demonstration Activities in 2010

Seventy one forage demonstration plots were established in Shindand (21) and Enjil (50) districts in Herat Province during the summer season of 2010.

Fourteen acres of farmer-owned land were cultivated by pearl millet for forage and seed production in Enjil and Shindand districts under the supervision of the AWATT Forage team and DAIL-extensions.

Seven tons of Urea and DAP and 140 kg of pearl millet seeds were provided by the AWATT Forage Program to seventy one farmers in order to fertilize and plant their forage demo plots. Every farmer received two 50 kg bags of Urea and DAP-fertilizer; the farmers paid 25% of the fertilizer costs and carried out all the agricultural practices in their own at their farms.
During the 2010 growing season, the AWATT Forage Program team worked closely with the DAIL extension workers to build their capacity and provide guidance on how they could perform their work effectively during pearl millet forage and seed production stages.

**On-Farm Demonstration Results**

- During the summer of 2010, farmers in Shindand district made the first cutting of their pearl millet forage in the middle of August, and the second cutting in the middle of September. Farmers reported both good growth of pearl millet and satisfaction with the impact on their animals.

- Abdul Ghafoor Khan, the MAIL Director of Extension Office in the Shindand district, monitored observed the feeding effects of forage pearl millet in a milking cow for 12 days. He recorded that a daily increase of 2 kg of milk;

- The pearl millet crop survey in Shindand showed that the average pearl millet production is 3.3 kg/m² (6,600 kg per jerib) per cut.

Similar activities have been conducted by the AWATT Forage team in Enjl District:

- In July-August 2010, the AWATT Forage team monitored the effect of forage Pearl millet in dairy cattle milk production. Three cows were quarantined and observed for a ten-day period in two villages to demonstrate the effect of Pearl millet in milk production. With AWATT’s guidance and supervision, the farmers were trained to observe and collect the research data (Mullah Jayllan and Mohammad Nahiam from Frashan village and Gull Ahamad from Qafslan village) during the feeding of pearl millet forage to cows.

- The farmers reported that an average of 2.4 Kg increased daily in milk production per cow and the average increase in milk fat production was 1.76 gram/daily as a result of switching the traditional low quality feeds to Pearl millet.
By switching traditional low quality feeds to pearl millet, farmers can increase their daily income, by 48 Afs (2.4kg x 20/Afs) per cow for milk and 24.6 Afs (1.76 gram x 14 Afs) per cow for milk fat. Therefore, a total of 72.6 Afs/day increase incomes per milking cow that fed on pearl millet will be obtained per household.

In the growing season of 2010, pearl millet forage data were collected and analyzed from 18 randomly selected demo plots in Enjil and Shindand districts. The obtained yield results are displayed below in Table (4) and Figure (4).

**Table 4. Average fresh forage yield of pearl millet (MTon/ha) obtained at 18 demonstration plots in two Districts in Herat Province in the summer growing season of 2010**

<table>
<thead>
<tr>
<th>NN</th>
<th>District Name</th>
<th>Number of Farmers</th>
<th>Average Fresh Forage Yield per Cut (MTon/ha)</th>
<th>Total Fresh Forage Yield (MTon/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cut - 1</td>
<td>Cut - 2</td>
</tr>
<tr>
<td>1</td>
<td>Enjil</td>
<td>9</td>
<td>36.00</td>
<td>43.00</td>
</tr>
<tr>
<td>2</td>
<td>Shindand</td>
<td>9</td>
<td>33.00</td>
<td>45.00</td>
</tr>
<tr>
<td></td>
<td>Average of Fresh Forage Yield (MTon/ha)</td>
<td>2</td>
<td>18</td>
<td>34.50</td>
</tr>
</tbody>
</table>

**Figure 4. Average fresh forage yield of pearl millet (MTon/ha) obtained at 18 demonstration plots in two Districts in Herat Province in the summer growing season of 2010**

**Summary of results**

- The obtained number of cuts was three cuts per summer growing season that was partly due to late plantation on July, 2010.
- The pearl millet fresh forage yield ranged from 103.0 – 105.0 MTon/ha per growing season from three cuts.
The overall average fresh forage yield of pearl millet over two districts per cut 1, 2, and 3 were 34.5, 44.0, and 25.72 MTon/ha per growing season of 2010.

The participating 71 farmers reported that they will replace Jawari by pearl millet after they planted at their farms, tested, fed to their livestock, increased milk production and increased their livestock’s weight gain.

The participating 71 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, and make it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

**Recommendations**

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop be registered and certified at MAIL Seed System as a new forage crop for the benefits of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.

- National Afghan seed enterprises should include the forage pearl millet as one of the first forage crops to be produced according to the new seed law of Afghanistan.
Parwan Province

At the request of the PRT in Parwan Province, the AWATT Forage Program was initiated activities in five districts in Parwan province: Jabal Seraaj, Seyagerd, Sayed Khel, Central Parwan, and Shenwari.

On Farm Demonstration Activities in 2010

During the 2010 growing season, Dr. Hamdy Oushy, the AWATT Forage & Rangeland Specialist, and the AWATT Forage Program Team Leader worked on the establishment and supervision of 250 forage demonstration plots (64 jeribs – 13 hectares in Parwan Province for the purpose of evaluating and demonstrating pearl millet forage to local farmers.

Pearl Millet Forage Yield Performance Results

The AWATT Forage Program team prepared layouts of 250 pearl millet forage demonstration plots in 5 districts in Parwan province. Forage data from three cuts at the farmers’ demo plots were collected by the MAIL extension workers and AWATT Forage team and analyzed for yield performance.

The forage pearl millet yield results obtained in 2010 from 230 demonstration plots (farms) are displayed below in Table (5) and Figure (5). Due to heavy flooding, 20 demonstration plots (farmers’) have been excluded from evaluation of pearl millet forage yield performance on farmer-owned land.
Table 5. Average fresh forage yield (MTon/ha) of pearl millet obtained at 230 demo plots in five Districts in Parwan Province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>NN</th>
<th>District Name</th>
<th>Number of Farmers</th>
<th>Average Fresh Forage Yield per Cut (MTon/ha)</th>
<th>Total Fresh Forage Yield (MTon/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cut - 1</td>
<td>Cut - 2</td>
</tr>
<tr>
<td>1</td>
<td>Shenwari</td>
<td>41</td>
<td>36.21</td>
<td>33.87</td>
</tr>
<tr>
<td>2</td>
<td>Seia Gerd</td>
<td>39</td>
<td>41.88</td>
<td>38.22</td>
</tr>
<tr>
<td>3</td>
<td>Central Parwan</td>
<td>50</td>
<td>48.15</td>
<td>42.30</td>
</tr>
<tr>
<td>4</td>
<td>Jabal Saraj</td>
<td>50</td>
<td>50.61</td>
<td>45.54</td>
</tr>
<tr>
<td>5</td>
<td>Sayeed Khail</td>
<td>50</td>
<td>58.06</td>
<td>54.06</td>
</tr>
<tr>
<td></td>
<td>Average of Fresh Forage Yield (MTon/ha)</td>
<td>5</td>
<td>230</td>
<td>46.98</td>
</tr>
</tbody>
</table>

Figure 5. Average fresh forage yield (MTon/ha) of pearl millet obtained at 230 demo plots in five Districts in Parwan Province in the summer growing season of 2010

Summary of results

- During the summer growing season of 2010, the forage pearl millet yield has been obtained from 3 cuts due only to the late plantation in July, 2010.
- The pearl millet fresh forage yield per growing season ranged from 99.9 – 160.2 MTon/ha.
- The overall average fresh forage yields of pearl millet over 5 districts during growing season of 2010 for cut 1, 2, and 3 were 47.0, 42.8, and 37.6 MTon/ha respectively.
- The participating 250 farmers reported that they will replace Jawari by pearl millet after they planted at their farms, tested, fed to their livestock, increased milk production and their livestock’s weight gain.
- The participating 250 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, and make it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.
Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop be registered and certified at MAIL Seed System as a new forage crop for the benefits of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.

- National Afghan seed enterprises should include the forage pearl millet as one of the first forage crops to be produced according to the new seed law of Afghanistan.
Nangarhar Province

In June 2010, the AWATT Forage Program had initiated its activities on pearl millet forage and seed production demonstration and testing in two districts in Nangarhar province: Kama and Behsood. Twenty farmers, 10 from each district, were selected to participate in the pearl millet on-farm demonstration and testing program.

On Farm Demonstration Activities in 2010

During the 2010 growing season, Dr. Hamdy Oushy, the AWATT Forage & Rangeland Specialist, and the AWATT Forage Program Team Leader in collaboration with AWATT forage team in Nangarhar developed and supervised of 20 pearl millet forage demonstration plots in 6 jeribs – 1.2 hectares in two districts in order to test and demonstrate it to local farmers:

- The AWATT Forage Program Team and DAIL-extension workers worked closely with the farmers in both districts to monitor their progress and provide guidance and necessary technical assistance. In addition, hand-on trainings were taken place with the DAIL extension workers to guide them and improve their capacity to perform their work effectively in forage technology transfer;
- All the demonstration plots were regularly visited by the AWATT Forage team and the DAIL extension workers;

Pearl Millet Forage Yield Performance Results

Forage data from three cuts at the farmers’ demo plots were collected by the MAIL extension workers and the AWATT Forage team and analyzed for yield performance. The forage pearl millet yield results obtained in 2010 at 13 demonstration plots (farms) in Nangarhar province
are displayed below in Table (6) and Figure (6). Due to heavy flooding, 7 demonstration plots (farmers) were excluded from evaluation of the pearl millet forage yield.

**Table 6. Average fresh forage yield (MTon/ha) of pearl millet obtained at 13 demo plots in 2 Districts in Nangarhar Province in the summer growing season of 2010**

<table>
<thead>
<tr>
<th>NN</th>
<th>District Name</th>
<th>Number of Farmers</th>
<th>Average Fresh Forage Yield per Cut (MTon/ha)</th>
<th>Total Fresh Forage Yield (MTon/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cut - 1</td>
<td>Cut - 2</td>
</tr>
<tr>
<td>1</td>
<td>Behsood</td>
<td>3</td>
<td>56.52</td>
<td>57.50</td>
</tr>
<tr>
<td>2</td>
<td>Kama</td>
<td>10</td>
<td>62.00</td>
<td>33.73</td>
</tr>
<tr>
<td></td>
<td><strong>Average of Fresh Forage Yield (MTon/ha)</strong></td>
<td><strong>13</strong></td>
<td><strong>59.26</strong></td>
<td><strong>45.61</strong></td>
</tr>
</tbody>
</table>

**Summary of results**

- During the summer growing season of 2010, the obtained number of cuts was three cuts that was partly due to the late plantation in July, 2010.
- The pearl millet fresh forage yield per growing season from three cuts ranged from 107.8 MTon/ha in Behsood and 165.7 MTon/ha in Kama districts.
- The overall average fresh forage yield of pearl millet per growing season of 2010 in two districts per cut 1, 2, and 3 were 59.3, 45.6, and 31.9 MTon/ha respectively.
- The participating 20 farmers reported that they will replace Jawari by Pearl millet after they planted at their farms, tested, fed to their livestock, increased milk production and their livestock’s weight gain.
• The participating 20 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, make it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

**Recommendations**

• Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.

• National Afghan seed enterprises should include the forage pearl millet as one of the first forage crops to be produced according to the new seed law of Afghanistan.
Kabul Province

In the summer of 2010, the AWATT Forage Program established seed and forage production demonstration plots at MAIL Badam-Bagh Research Farm (BBF) and at the College of Agriculture Agronomic Research Farm, Kabul University in Kabul City, Kabul Province.

MAIL Badam-Bagh Research Farm (BBF)

Forage pearl millet demonstration plots

A plot furrows demonstration was established for each of the forage crops: pearl millet, Sudan grass, cowpea, and alfalfa seed and forage production.

The results for the fresh forage yield of pearl millet forage crops obtained at MAIL Badam-Bagh Research Farm in the summer growing season of 2010 are displayed in Table (7) and Figure (7).

Table 7. Average fresh forage yield (MTon/ha) of pearl millet obtained from two cuts at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>NN</th>
<th>Station Name</th>
<th>Forage Crop</th>
<th>Cut</th>
<th>No of Replications</th>
<th>Average Fresh Yield Per Cut</th>
<th>St. Dev. Fresh Forage Yield</th>
<th>Range of Fresh Forage Yield</th>
<th>Total Fresh Forage Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAIL Badam Bagh Farm</td>
<td>Pearl Millet</td>
<td>1</td>
<td>12</td>
<td>48.29</td>
<td>11.38</td>
<td>31.0 - 63.5</td>
<td>93.92</td>
</tr>
<tr>
<td>2</td>
<td>Pearl Millet</td>
<td>2</td>
<td>12</td>
<td>45.63</td>
<td>5.20</td>
<td>37.5 - 50.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7. Average of the fresh forage yield (MTon/ha) of pearl millet obtained from two cuts at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010
Summary of results

- Two cuts were obtained per summer growing season that was partly due to the late plantation in July, 2010; in addition to the relatively low temperatures in Kabul.
- The total fresh forage pearl millet yield per growing season from two cuts was 93.92 MTon/ha.
- The fresh forage yields recorded per cut 1 and 2 were 48.3 and 45.6 MTon/ha respectively.

Recommendations

- Based on the above documented results and findings, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet, be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as one of the first forage crops to be produced according to the new seed law of Afghanistan.

Forage alfalfa demonstration plots

The results for the fresh forage yield of alfalfa (Server form Australia) obtained at MAIL Badam-Bagh Research Farm in the summer growing season of 2010 are displayed in Table (8) and Figure (8).

Table 8. Average fresh forage yield (MTon/ha) of alfalfa obtained from three cuts at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>NN</th>
<th>Station Name</th>
<th>Forage Crop</th>
<th>Cut</th>
<th>No of Replications</th>
<th>Average Fresh Forage Yield</th>
<th>St. Dev. Fresh Forage Yield</th>
<th>Range of Fresh Forage Yield</th>
<th>Total Fresh Forage Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAIL Badam Bagh Farm</td>
<td>Alfalfa</td>
<td>1</td>
<td>16</td>
<td>22.93</td>
<td>2.87</td>
<td>14.8 - 26.3</td>
<td>65.17</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Alfalfa</td>
<td>2</td>
<td>16</td>
<td>23.91</td>
<td>2.21</td>
<td>20.5 - 27.3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Alfalfa</td>
<td>3</td>
<td>16</td>
<td>18.33</td>
<td>1.81</td>
<td>15.0 - 21.0</td>
<td></td>
</tr>
</tbody>
</table>
Figure 8. Average of the fresh forage yield (MTon/ha) of alfalfa obtained from three cuts at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010.

Summary of results

- The obtained number of cuts was three cuts per summer growing season that was partly due to the late plantation in July, 2010.
- The total fresh forage pearl millet yield per growing season from three cuts was 65.17 MTon/ha.
- The fresh forage yields recorded per cut 1, 2 and 3 were 22.9, 23.9 and 18.3 MTon/ha respectively.

Recommendations

- Alfalfa as a perennial legume forage crop needs at least three year continuous evaluation trial in order to evaluate the yield performance, quality, and persistence.
- Based on the above documented results and findings, we recommend that more time is needed to evaluate the verity and make conclusion.
- We recommend keeping this experiment running for at least three years to make conclusion and inference.
Agronomic Research Farm, Kabul University

In June 2010, the AWATT Forage Program established applied forage irrigation research and demonstration programs at the Agronomic Research Farm, Kabul University which was in addition to alternative and furrow irrigation systems demonstrations for pearl millet, sudan grass and cowpea.

Irrigation systems for every furrow and for alternate furrows were demonstrated on seed production plots.

The results for fresh forage yield of Sudan grass obtained at Kabul University Agronomic Research Farm in the summer growing season of 2010 are displayed in Table (9) and Figure (9).

Table 9. Average fresh forage yield (MTon/ha) of sudan grass obtained from Kabul University Agronomic Research Farm, Kabul Province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>NN</th>
<th>Station Name</th>
<th>Forage Crop</th>
<th>Cut</th>
<th>No of Replications</th>
<th>Average Fresh Yield Per Cut</th>
<th>St. Dev. Fresh Forage Yield</th>
<th>Range of Fresh Forage Yield</th>
<th>Total Fresh Forage Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kabul University</td>
<td>Sudan Grass</td>
<td>1</td>
<td>16</td>
<td>29.72</td>
<td>12.87</td>
<td>14.8 - 54.0</td>
<td>58.97</td>
</tr>
<tr>
<td>2</td>
<td>Kabul University</td>
<td>Sudan Grass</td>
<td>2</td>
<td>16</td>
<td>29.25</td>
<td>8.80</td>
<td>17.5 - 49.5</td>
<td></td>
</tr>
</tbody>
</table>
Figure 9. Average of fresh forage yield (MTon/ha) of sudan grass obtained from two cuts at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010

Summary of results

- The obtained number of cuts was two cuts per summer growing season that was partly due to the late plantation in July, 2010.
- The total fresh forage yield was 59.0 MTon/ha for sudan grass per growing season from two cuts.
- The fresh forage yields recorded per cut 1 and 2 were 29.7 and 29.3 MTon/ha respectively.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage Sudan grass be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage sudan grass as the second forage crop after pearl millet to be produced according to the new seed law of Afghanistan.
Logar Province

In June 2010, in collaboration between the AWATT Forage Technology Transfer Program and the Kabul Dairy Union (KDU), a forage extension program had been initiated for 10 members of the Union in two districts: Puli-E-Alam and Mohd Agha in Logar province.

Ten forage demonstration plots have been implemented in two districts in Logar province, where five demonstration plots were established in each district, 1.25 acres of farmers’ owned land that was cultivated with pearl millet for forage and seed production.
Wardak Province

In June 2010, in collaboration between the AWATT Forage Technology Transfer Program and the Kabul Dairy Union (KDU), a forage extension program had been initiated for 10 members of the Union in two districts: Nirkh and Maydan Shahr in Wardak province.

Ten forage demonstration plots have been implemented in two districts in Wardak province, where five demonstration plots were established in each district, 1.25 acres of farmers owned land that was cultivated with pearl millet for forage and seed production.
Forage Applied Research Trials

The main objectives of AWATT Forage Applied Research activities are:

- To test and evaluate the yield performance of the introduced improved forage crops under different agro-ecological zones in Afghanistan in comparison with local yellow corn;
- To apply forage trials to determine the best N-Fertilizer application;
- To improve the MAIL forage research base and the researchers’ capacity building;
- To improve the research base and the research capacity building among the faculty members of the Colleges of Agriculture at Afghan Universities in seven selected provinces;
- To produce forage extension, fact sheets and training materials based on the research outcome results and findings for MAIL extension workers and farmers.

According to the Afghan seed law, testing trials need to be performed in MAIL lands prior to registering and certifying any new plant variety for three years. Therefore, since 2009 the AWATT Forage Program has initiated a series of testing trials for yield performance in comparison with local and exotic forage summer crops over extended geographical areas in Afghanistan.

Twenty forage trials in irrigation, varietal comparison, nitrogen fertilizer, and seed production were applied through 2009-2011 in: 1) Balkh Province at MAIL Dehdadi Agricultural Research Station and Agronomic Research Farm at Balkh University; 2) Herat province at MAIL Herat Agricultural Research Station and College of Agriculture Agronomic Research Farm at Herat University; 3) Kabul province at MAIL Badam Bagh Research Farm and College of Agriculture Agronomic Research Farm at Kabul University; 4) Nangarhar province at MAIL Shishem Bagh Research Farm and College of Agriculture Agronomic Research Farm at Nangarhar University.

Balkh Province

In June 2009, the first forage research and demonstration sites for pearl millet (Shandawel-1 open pollinated variety from Egypt), were established as newly introduced forage to Afghanistan at the MAIL Dehdadi Agricultural Research Station and the Agronomic Research Farm at Balkh University in Balkh Province.

MAIL Dehdadi Agricultural Research Station, 2009

In the summer of 2009, three applied forage research trials were carried out by the AWATT Forage Program at MAIL Dehdadi Agricultural Research Station in Dehdadi District, Balkh Province. These three research demonstrations include:
• Assessing the performance of the pearl millet forage crop under differing Nitrogen fertilizer regiments;
• Assessing the varietal performance of the newly introduced forage pearl millet in comparison with the local forage Jawari (Yellow corn) and forage sorghum/sudan grass hybrid;
• Observing the pearl millet seed production performance characteristics under Balkh province environmental conditions.

Forage pearl millet research trials and seed production observing plots at the MAIL Dehdadi Research Station, Balkh Province in 2009

In order to achieve one of the major objectives of the AWATT Forage Program in Afghanistan, and to provide assessment and evaluation of yield performance and practical recommendations to the Afghanistan national and local government, to extension service agencies, and to farmers, the AWATT forage team provided statistical analysis of forage data collected at the MAIL Dehdadi Agricultural Research Station for each of the three applied forage research trials.

AWATT forage team and MAIL extension staff collecting forage data from demo plots at farmer-owned land
The First Comparison Experiment According to Afghan Seed Law: Forage Crops Varietal Comparison Trial

Experimental title: Forage yield performance of pearl millet (Pennisetum glaucum), sorghum/Sudan grass hybrid and local Jawari (yellow corn) under MAIL-Dehdadi, Balkh Province conditions in Afghanistan.

Experimental objectives

- To evaluate the fresh and dry yield performance of pearl millet in comparison with two forage crops under Dehdadi conditions;
- To recommend the best performing forage crop for Dehdadi environmental conditions in Balkh Province;
- To demonstrate the forage best agricultural practices and train MAIL-researchers, extension workers, faculty and students of Balkh University in forage extension and varietal research;
- To produce a farmers’ field guide for farmers and extension agents in Dari and Pashto about pearl millet’s best agricultural practices.

Forage crops varietal comparison trial results

Yield results of three forage crop varietal comparison trial obtained at MAIL Dehdadi Agricultural Research Station, Balkh Province in the summer growing season of 2009 are displayed below in Table (10) and Figure (10 and 11).
Table 10. Total dry forage yield (MTon/ha) of the three tested forage crops as a percentage of the total accumulated yield obtained from three cuts at the MAIL-Dehdadi Research Station, Balkh Province in the summer growing season of 2009

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>First Cut</th>
<th>Second Cut</th>
<th>Third Cut</th>
<th>Total of 3 cuts (MTon/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry Yield</td>
<td>% of the total</td>
<td>Dry Yield</td>
<td>% of the total</td>
</tr>
<tr>
<td></td>
<td>(MTon/ha)</td>
<td></td>
<td>(MTon/ha)</td>
<td></td>
</tr>
<tr>
<td>Pearl Millet</td>
<td>3.65&lt;sup&gt;A&lt;/sup&gt;</td>
<td>38.31</td>
<td>2.92&lt;sup&gt;A&lt;/sup&gt;</td>
<td>30.71</td>
</tr>
<tr>
<td>Sorghum/sudan grass hybrid</td>
<td>3.08&lt;sup&gt;A&lt;/sup&gt;</td>
<td>60.26</td>
<td>1.48&lt;sup&gt;B&lt;/sup&gt;</td>
<td>28.88</td>
</tr>
<tr>
<td>Yellow Corn (Jawari)</td>
<td>3.66&lt;sup&gt;A&lt;/sup&gt;</td>
<td>100.00</td>
<td>0.00&lt;sup&gt;C&lt;/sup&gt;</td>
<td>0.00</td>
</tr>
<tr>
<td>CV (%):</td>
<td>16.67</td>
<td></td>
<td>39.65</td>
<td></td>
</tr>
<tr>
<td>LSD (0.05):</td>
<td>1.00</td>
<td></td>
<td>1.01</td>
<td></td>
</tr>
<tr>
<td>LSD (0.05): Pearl Millet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05): Sorghum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 10. Dry forage yield (MTon/ha) distribution per cut of the tested three forage crops obtained from three cuts at MAIL-Dehdadi Research Station, Balkh Province in the summer growing season of 2009
Practical implementation

- Pearl millet (Shandawel-1 variety from Egypt) introduced to Afghanistan by AWATT had the highest dry forage yield with 9.51 tons per hectare, which was 160% greater than Jawari and 86% greater than sorghum/sudan grass hybrid (Mabrouk hybrid) from Egypt;
- Pearl millet also has a higher water use efficiency than the other crops, which makes it an excellent choice for Afghan growing conditions;
- Pearl millet proved its superiority as a potentially high yielding and drought-resistant summer forage crop for Afghan farmers, herders and families with household livestock;
- Capacity building for MAIL researchers and Balkh University faculty and students on the applied forage research;
- Strengthen the national research base of MAIL and Universities;
- Strengthen the collaborations between MAIL and Universities on applied research and extension;
- Producing a field guide on forage best agricultural practices for MAIL, farmers and extension agents;
- Recommending registration and multiplication of the newly introduced pearl millet by the MAIL-seed system and extension in order to distribute it nationwide as a potential high yielding, drought resistance crop and highly nutritional value crop for Afghan farmers and herders.

Recommendations

- We do recommend registration, certification and multiplication of the proven introduced pearl millet by the MAIL-seed system in order to distribute it nationwide as
the potential forage high yielding, drought resistance and highly nutritional value crop for Afghan farmers and herders.

- We do recommend MAIL to contract National seed multiplication enterprises to produce the certified seeds of pearl millet in order to be available for Afghan farmers and herders.

**Nitrogen Fertilizer Trial**

**Experimental title:** Effect of different nitrogen fertilizer rates on the forage yield of pearl millet (*Pennisetum glaucum*) Shandawil-1, under MAIL Dehdadi-Balkh environmental conditions in Afghanistan.

**Experimental objectives**
- To evaluate the fresh and dry matter yield of pearl millet under different N fertilizer rates;
- To recommend the appropriate N fertilizer rate for pearl millet under Dehdadi District environmental conditions in Balkh Province.

**Dry forage nitrogen trials results**

Yield results of the effect of different nitrogen fertilizer rates on the forage yield of pearl millet obtained at MAIL Dehdadi Agricultural Research Station, Balkh province in the summer growing season of 2009 are displayed below in Table (11) and Figure (12 and 13).

*Table 11. Total dry forage yield (MTon/ha) of pearl millet under three levels of nitrogen fertilizer application obtained from three cuts at MAIL Dehdadi Agricultural Research Station, Balkh Province in the summer growing season of 2009.*

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>N - 1 (198 kg/ha)</th>
<th>N - 1 (295.5 kg/ha)</th>
<th>N - 1 (395 kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearl Millet:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut - 1</td>
<td>3.50</td>
<td>3.86</td>
<td>3.27</td>
</tr>
<tr>
<td>Cut - 2</td>
<td>2.65</td>
<td>2.66</td>
<td>2.16</td>
</tr>
<tr>
<td>Cut - 3</td>
<td>2.65</td>
<td>2.59</td>
<td>2.60</td>
</tr>
<tr>
<td>Total Cuts:</td>
<td>8.80</td>
<td>9.11</td>
<td>8.03</td>
</tr>
<tr>
<td>LSD (0.05) Cut - 1</td>
<td>2.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 2</td>
<td>3.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 3</td>
<td>1.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Total Cuts</td>
<td>7.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV (%)</td>
<td>10.89</td>
<td>5.73</td>
<td>8.75</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>1.37</td>
<td>0.75</td>
<td>1.01</td>
</tr>
</tbody>
</table>
Results and recommendations

- No significant differences among the three nitrogen fertilizer rates;
- Further research will be applied this summer to test lower nitrogen fertilizer rates than N-198 Kg unit;
- Soil testing analysis will be carried out to test the chemical and physical characteristics of the experimental plots before initiating the trial.
Agronomic Research Farm, Balkh University, 2009

The Second Comparison Experiment According to Afghan Seed Law: Forage Crops Varietal Comparison Trial

**Experimental title:** Forage yield performance of pearl millet (Pennisetum glaucum), sorghum/Sudan grass hybrid and local Jawari (yellow corn) under Mazar-e-Sharif-Balkh University environmental conditions in Afghanistan.

**Experimental objectives**
- To evaluate the yield performance of the three forage crops and select the superior one;
- To strengthen the applied research base, demonstrate and train MAIL-researchers, Balkh University faculty members and students in forage research;
- To produce a farmers’ field guide for farmers and extension agents in the local language Dari and Pashto.

Forage crops varietal comparison trial results

Results displayed in Table (12) and Figure (14 and 15) showed that pearl millet (Shandawel-I variety) had the highest fresh forage yield (53.10 tons/ha), which was 448.5 % greater than Jawari and 24.6 % greater than sorghum/Sudan grass hybrid (Mabrouk hybrid) from Egypt.

**Table 12. Total dry forage yield (ton/ha) of the three tested forage crops as a percentage of the total accumulated yield obtained from three cuts at the College of Agriculture, Balkh University in the summer growing season of 2009**

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>First Cut</th>
<th></th>
<th>Second Cut</th>
<th></th>
<th>Third Cut</th>
<th></th>
<th>Fourth Cut</th>
<th></th>
<th>Total of 4 cuts (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry Yield (ton/ha) % of the total</td>
<td>Dry Yield (ton/ha) % of the total</td>
<td>Dry Yield (ton/ha) % of the total</td>
<td>Dry Yield (ton/ha) % of the total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearl Millet</td>
<td>12.87 a</td>
<td>24.23</td>
<td>18.41 a</td>
<td>34.65</td>
<td>13.13 a</td>
<td>24.71</td>
<td>8.72 a</td>
<td>16.41</td>
<td>53.13 a</td>
</tr>
<tr>
<td>Sorghum/sudan grass hybrid</td>
<td>11.66 b</td>
<td>27.34</td>
<td>15.59 b</td>
<td>36.57</td>
<td>8.10 b</td>
<td>18.99</td>
<td>7.29 a</td>
<td>17.10</td>
<td>42.64 b</td>
</tr>
<tr>
<td>Yellow Corn (Jawari)</td>
<td>9.68 c</td>
<td>100.00</td>
<td>0.00 c</td>
<td>0.00</td>
<td>0.00 c</td>
<td>0.00</td>
<td>0.00 b</td>
<td>0.00</td>
<td>9.68 c</td>
</tr>
<tr>
<td>CV (%):</td>
<td>2.45</td>
<td>12.99</td>
<td>22.84</td>
<td>20.68</td>
<td>8.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05):</td>
<td>0.48</td>
<td>2.55</td>
<td>2.80</td>
<td>1.91</td>
<td>5.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05): Pearl Millet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05): Sorghum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Practical implementation

- Pearl millet had the highest fresh forage yield with 53.13 tons per hectare, which was 548.9 % greater than Jawari and 124.6% greater than sorghum/Sudan grass hybrid;
- Pearl millet also has a higher water use efficiency than the other crops, which makes it an excellent choice for Afghan growing conditions;
Pearl millet proved its superiority as a potentially high yielding and drought-resistant summer forage crop for Afghan farmers, herders and families with household livestock.

**Recommendations**

- We do recommend registration, certification and multiplication of the proven introduced pearl millet by the MAIL-seed system in order to distribute it nationwide as the potential forage high yielding, drought resistance and highly nutritional value crop for Afghan farmers and herders.
- We do recommend MAIL to contract National seed multiplication enterprises to produce the certified seeds of pearl millet in order to be available for Afghan farmers and herders.
Herat Province

Ten experimental plots for forage and seed production testing were established at MAIL Herat Agricultural Research Station (5) and College of Agriculture Agronomic Research Farm, Herat University (5) in Herat Province in the summer growing season of 2010.

MAIL-Herat Agricultural Research Station (MHARS) in Enjil District, 2010

Five applied forage research trials in four Jeribs have been carried out by the AWATT Forage Program at MAIL-Herat Agricultural Research Station (MHARS) in Enjil District with a total of twenty Jeribs (10 acres) of land as follows:

- Two fertilizer experiments on pearl millet and sudan grass;
- Forage varietal comparison experiment with pearl millet, sudan grass and Jawari, a local forage crop;
- Forage mixture experiments with cowpea/pearl millet, cowpea/sudan grass, and cowpea/Jawari;
- Forage crop foundation seed production demonstration plots of pearl millet, sudan grass and cowpea.

Collected forage data were evaluated by the AWATT Forage Technology Transfer team and, the yield results obtained in the summer growing season of 2010 are introduced in the following sections.
Nitrogen Fertilizer Trials

**Experimental title:** Effects of different nitrogen fertilizer rates on the forage yield of pearl millet (Pennisetum glaucum) and Sudan grass, under MHARS, Herat province environmental conditions in Afghanistan.

**Experimental objectives**
- To evaluate the fresh yield of pearl millet and Sudan grass under different N fertilizer rates;
- To recommend the appropriate N fertilizer rate for pearl millet and Sudan grass under MHARS conditions in Herat Province.

**Fresh forage nitrogen trials results**

Yield results of different nitrogen fertilizer rates effect on the forage yield of pearl millet obtained at MAIL Herat Agricultural Research Station, Herat province in the summer growing season of 2010 are displayed below in Table (13) and Figure (16 and 27).

**Table 13. Total fresh forage yield (MTon/ha) of pearl millet under four levels of nitrogen fertilizer application obtained from two cuts at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010**

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>N - 1 (0 kg/ha)</th>
<th>N - 2 (110 kg/ha)</th>
<th>N - 3 (240 kg/ha)</th>
<th>N - 4 (325 kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearl Millet (MTon/ha):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut - 1</td>
<td>12.20 (^A)</td>
<td>12.29 (^A)</td>
<td>10.97 (^A)</td>
<td>10.61 (^A)</td>
</tr>
<tr>
<td>Cut - 2</td>
<td>17.81 (^B, C)</td>
<td>19.22 (^A, B)</td>
<td>22.43 (^A)</td>
<td>15.03 (^C)</td>
</tr>
<tr>
<td>Total Cuts:</td>
<td>30.01 (^A, B)</td>
<td>31.51 (^A)</td>
<td>33.40 (^A)</td>
<td>25.64 (^B)</td>
</tr>
<tr>
<td>LSD (0.05) Cut - 1</td>
<td>2.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 2</td>
<td>3.53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Total Cuts</td>
<td>4.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV (%)</td>
<td>8.21</td>
<td>9.19</td>
<td>20.26</td>
<td>7.95</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>2.77</td>
<td>3.26</td>
<td>7.61</td>
<td>2.29</td>
</tr>
</tbody>
</table>
Figure 16. Total fresh forage yield (MTon/ha) of pearl millet per N-treatment at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010

![Total Pearl Millet Fresh Forage Yield](Figure16.png)

Figure 17. Fresh forage yield (MTon/ha) distribution per cut for four different levels of N-fertilizer of pearl millet at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010

![Pearl Millet Fresh Forage Yield per Cut with Different Fertilizer Rates](Figure17.png)

Yield results of different nitrogen fertilizer rates effect on the forage yield of Sudan grass obtained at MAIL Herat Agricultural Research Station, Herat province in the summer growing season of 2010 are displayed below in Table (14) and Figure (18 and 19).
Table 14. Total fresh forage yield (MTon/ha) of Sudan grass under four levels of nitrogen fertilizer application obtained from two cuts at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>N - 1</th>
<th>N - 2</th>
<th>N - 3</th>
<th>N - 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0 kg/ha)</td>
<td>(110 kg/ha)</td>
<td>(240 kg/ha)</td>
<td>(325 kg/ha)</td>
</tr>
<tr>
<td>Sudan Grass (MTon/ha):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut - 1</td>
<td>11.94 A</td>
<td>12.12 A</td>
<td>10.72 A</td>
<td>11.06 A</td>
</tr>
<tr>
<td>Cut - 2</td>
<td>13.58 A</td>
<td>13.09 A</td>
<td>14.44 A</td>
<td>10.08 B</td>
</tr>
<tr>
<td>Total Cuts:</td>
<td>25.52 A</td>
<td>25.21 A,B</td>
<td>25.16 A,B</td>
<td>21.14 B</td>
</tr>
<tr>
<td>LSD (0.05) Cut - 1</td>
<td></td>
<td></td>
<td>3.17</td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 2</td>
<td></td>
<td></td>
<td>2.93</td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Total Cuts</td>
<td></td>
<td></td>
<td>4.14</td>
<td></td>
</tr>
<tr>
<td>CV (%)</td>
<td>16.62</td>
<td>4.12</td>
<td>22.79</td>
<td>29.33</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>4.77</td>
<td>1.17</td>
<td>6.45</td>
<td>6.98</td>
</tr>
</tbody>
</table>

Figure 18. Total fresh forage yield (MTon/ha) of Sudan grass per N-treatment at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010
Summary of results

- No significant differences among the four nitrogen fertilizer rates; this may be due to the fact that we the experiment was planted after local Afghan clover in winter in which that enough nitrogen atmosphere was fixed by the clover in soil. Therefore, that may be considered as experimental errors that resulted in no significant differences among treatments. This is very obvious with the control treatment results compared with the highest N treatment application.

Recommendations

- We recommend that this experiment should be replicated next summer after wheat.
Forage Crops Varietal Comparison Trial

**Experimental title:** Forage yield performance of pearl millet (Pennisetum glaucum), sudan grass and local Jawari (yellow corn) under MAIL, Herat province environmental conditions in Afghanistan in 2010.

**Experimental objectives**

- To evaluate the fresh yield of the three forage crops under MHARS, Herat province conditions;
- To recommend the best performing forage crop for MHARS type conditions in Herat Province;
- To demonstrate the forage best practices and train MAIL-researchers, faculty and students in forage varietal research;
- To produce a farmers’ field guide for farmers and extension agents in the local languages of Dari and Pashto about pearl millet’s best agricultural practices.

**Forage crops varietal comparison trial results**

Yield results of three forage crop varietal comparison trial obtained at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010 are displayed below in Table (15) and Figure (20 and 21).

**Table 15. Total Fresh forage yield (MTon/ha) of the three tested forage crops as a percentage of the total accumulated yield obtained from two cuts at the MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010**

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>First Cut</th>
<th>Second Cut</th>
<th>Total of 2 cuts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield</td>
<td>% of the total</td>
<td>Yield</td>
</tr>
<tr>
<td>Sudan Grass</td>
<td>26.00</td>
<td>48.44</td>
<td>27.67</td>
</tr>
<tr>
<td>Pearl Millet</td>
<td>26.67</td>
<td>48.78</td>
<td>28.00</td>
</tr>
<tr>
<td>Yellow Corn (Jawari)</td>
<td>26.80</td>
<td>100.00</td>
<td>0.00</td>
</tr>
<tr>
<td>CV (%)</td>
<td>17.40</td>
<td>23.18</td>
<td>19.27</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>10.45</td>
<td>9.75</td>
<td>19.68</td>
</tr>
<tr>
<td>LSD (0.05) Sudan Grass</td>
<td>8.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Pearl Millet</td>
<td>14.42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Due to late plantation, on July 2010, in this experiment only two cuts were obtained.
Summary of results

- Due to late plantation, in July 2010, the forage pearl millet yield has been obtained in this experiment from two cuts only.
The total fresh forage yields from two cuts were 54.7, 53.7, and 26.8 MTON/ha for pearl millet, Sudan grass and Jawari per growing season respectively.

In comparison with the only local existing traditional summer forage crop Jawari (local yellow corn), pearl millet proved superior and produces two times as much fresh yield (54.7 MTON/ha) as Jawari (26.8 MTON/ha per season).

The participating 71 farmers reported that they will replace Jawari with pearl millet after plantation at their farms, testing, feeding their livestock, increasing milk production and the weight gain of their livestock.

The participating 71 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, making it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

**Recommendations**

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop to be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.

- National Afghan seed enterprises should include the forage pearl millet as one of the first forage crops to be produced according to the new seed law of Afghanistan.

**College of Agriculture, Herat University, 2010**

In June 2010, the College of Agriculture of Herat University provided two *jeribs* (1 acre) of land to the AWATT Forage Program. All experimental plots were planted in the middle of July. During July-August 2010, the AWATT Forage team cultivated the plots at the Agronomic Research Farm (all approximately 4m2) to research crop growth using different fertilizers and crop mixes.

*The AWATT experimental trials preparation at Agronomic Research Farm on Campus of Herat University, Herat City in 2010.*
Five applied forage research trials have been carried out by the AWATT Forage Program team in cooperation with faculty members and students at the Agronomic Research Farm of the College of Agriculture, Herat University:

- Two Nitrogen fertilization experiments on pearl millet and Sudan grass;
- Forage crop varietal comparison experiment with pearl millet, Sudan grass, and Jawari, a local forage crop;
- Forage mixture experiments for cowpea/pearl millet, cowpea/Sudan grass, and cowpea/Jawari;
- Forage crop seed production demonstration plots.

In August 2010, the nitrogen fertilization plots received first and second doses of nitrogen fertilizer applied to seed production plots; they were also weeded, irrigated, and thinned. A first cutting was made of all experimental plots.

In September 2010, a third dose of nitrogen fertilizer was applied to the nitrogen fertilization plots. A second cutting was made of all experimental plots.

Results for the forage mixture plots were documented by the MAIL extension workers and AWATT Forage Team for the future analysis.

Collected forage data were evaluated by the AWATT Forage Technology Transfer team and, the yield results are introduced in the following sections.

**Nitrogen Fertilizer Trials**

**Experimental title:** Effects of different nitrogen fertilizer rates on the forage yield of pearl millet (Pennisetum glaucum) and Sudan grass, under the Agronomic Research Farm of the College of Agriculture, Herat University, Herat province environmental conditions in Afghanistan.

**Experimental objectives**

- To evaluate the fresh yield of pearl millet and Sudan grass under different N fertilizer rates;
- To recommend the appropriate N fertilizer rate for pearl millet and Sudan grass under Agronomic Research Farm of the College of Agriculture, Herat University conditions in Herat Province.

**Fresh forage nitrogen trials results**

**Pearl millet Fertilizer Trial**

Yield results of different nitrogen fertilizer rates effect on the forage yield of pearl millet obtained at the Agronomic Research Farm of the College of Agriculture, Herat University, Herat province in the summer growing season of 2010 are displayed below in Table (16) and Figure (22 and 23).
Table 16. Total fresh forage yield (MTon/ha) of pearl millet under four levels of nitrogen fertilizer application obtained from two cuts at Agronomic Research Farm of the College of Agriculture, Herat University in Herat Province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>N - 1</th>
<th>N - 2</th>
<th>N - 3</th>
<th>N - 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0 kg/ha)</td>
<td>(110 kg/ha)</td>
<td>(240 kg/ha)</td>
<td>(325 kg/ha)</td>
</tr>
<tr>
<td>Pearl Millet (MTon/ha):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut - 1</td>
<td>15.16 A</td>
<td>14.53 A</td>
<td>13.33 A</td>
<td>15.70 A</td>
</tr>
<tr>
<td>Cut - 2</td>
<td>25.70 A</td>
<td>27.73 A</td>
<td>25.47 A</td>
<td>26.05 A</td>
</tr>
<tr>
<td>Cut - 3</td>
<td>14.25 A</td>
<td>15.47 A</td>
<td>15.06 A</td>
<td>16.56 A</td>
</tr>
<tr>
<td>Total Cuts:</td>
<td>55.11 A</td>
<td>57.73 A</td>
<td>53.86 A</td>
<td>58.31 A</td>
</tr>
<tr>
<td>LSD (0.05) Cut - 1</td>
<td>3.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 2</td>
<td>3.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 3</td>
<td>4.54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Total Cuts</td>
<td>5.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV (%)</td>
<td>16.02</td>
<td>12.83</td>
<td>11.07</td>
<td>22.67</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>5.09</td>
<td>4.27</td>
<td>3.44</td>
<td>7.62</td>
</tr>
</tbody>
</table>

Figure 22. Total fresh forage yield (MTon/ha) of pearl millet per N-treatment at Agronomic Research Farm of the College of Agriculture, Herat University in Herat Province in the summer growing season of 2010
Summary of results

- No significant differences among the four nitrogen fertilizer rates for Pearl millet; this may be due to the fact that the experiment may be planted after local Afghan clover in winter. In addition, it may be due to the fact that pearl millet has low nitrogen requirement. This is very obvious with the control treatment results compared with the highest N treatment application.

Recommendations

- We recommend that pel millet could be planted and produce good yield without chemical fertilizer if we implemented a proper crop rotation in which forage legume or legume crop should be incorporated in the crop rotation.
- A proper, healthy and sustainable crop rotation needs to be implemented in small farming system in Afghanistan. This will enhance N-fixation, improve soil fertility, and reduce chemical fertilizer used.

Sudan Grass Fertilizer Trial

Yield results of different nitrogen fertilizer rates effect on the forage yield of sudan grass obtained at the Agronomic Research Farm of the College of Agriculture, Herat University, Herat province in the summer growing season of 2010 are displayed below in Table (17) and Figure (24 and 25).
**Table 17. Total fresh forage yield (MTon/ha) of sudan grass under four levels of nitrogen fertilizer application obtained from two cuts at the Agronomic Research Farm of the College of Agriculture, Herat University in Herat Province in the summer growing season of 2010**

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>N - 1</th>
<th>N - 2</th>
<th>N - 3</th>
<th>N - 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudan Grass</td>
<td>(0 kg/ha)</td>
<td>(110 kg/ha)</td>
<td>(240 kg/ha)</td>
<td>(325 kg/ha)</td>
</tr>
<tr>
<td>Cut - 1</td>
<td>10.03 A</td>
<td>11.21 A</td>
<td>11.11 A</td>
<td>11.58 A</td>
</tr>
<tr>
<td>Cut - 2</td>
<td>18.75 A, B</td>
<td>20.88 A, B</td>
<td>22.69 A, B</td>
<td>25.29 A</td>
</tr>
<tr>
<td>Cut - 3</td>
<td>9.69 A</td>
<td>10.81 A</td>
<td>12.88 A</td>
<td>11.50 A</td>
</tr>
<tr>
<td>Cut - 4</td>
<td>10.63 A</td>
<td>12.63 A</td>
<td>15.81 A</td>
<td>12.25 A</td>
</tr>
<tr>
<td>Total Cuts</td>
<td>49.09 A</td>
<td>55.53 A</td>
<td>62.49 A</td>
<td>60.61 A</td>
</tr>
<tr>
<td>LSD (0.05) Cut - 1</td>
<td>2.98</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 2</td>
<td>5.42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 3</td>
<td>4.49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cut - 4</td>
<td>7.53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Total Cuts</td>
<td>13.52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV (%)</td>
<td>20.46</td>
<td>26.51</td>
<td>12.06</td>
<td>23.03</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>4.02</td>
<td>5.89</td>
<td>3.01</td>
<td>5.58</td>
</tr>
</tbody>
</table>

**Figure 24. Total fresh forage yield (MTon/ha) of sudan grass per N-treatment at Agronomic Research Farm of the College of Agriculture, Herat University in Herat Province in the summer growing season of 2010**

![Total Sudan Grass Fresh Forage Yield](chart.png)

**Legend:**
- N - 0 kg
- N - 110 kg
- N - 240 kg
- N - 325 kg
Summary of results

- No significant differences among the four nitrogen fertilizer rates for Sudan grass; this may be due to the fact that the experiment may be planted after local Afghan clover in winter. In addition, it may be due to the fact that Sudan grass has low nitrogen requirement. This is very obvious with the control treatment results compared with the highest N treatment application.

Recommendations

- We recommend that Sudan grass could be planted and produce good yield without chemical fertilizer if we implemented a proper crop rotation in which forage legume or legume crop should be incorporated in the crop rotation.
- A proper, healthy and sustainable crop rotation needs to be implemented in small farming system in Afghanistan. This will enhance N-fixation, improve soil fertility, and reduce chemical fertilizer used.
Nangarhar Province

Agronomic Research Farm, Nangarhar University, 2010-2011

Egyptian and Local Clover Forage Varietal Comparison Trial

In the winter growing season of 2010/2011, an Egyptian clover varietal comparison experiment was established at the College of Agriculture Agronomic Research Farm, Nangarhar University, Jalalabad in Nangarhar Province.

Experimental title: Varietal Comparison Trial of Six Egyptian and Local Clover Varieties: Hellaly, Sakha-4, Gemiza-1, Serw-1, Fahl, and Giza-6 under Nangarhar University Agronomic Research Farm, Nangarhar Province Environmental Condition in Afghanistan.

Experimental objectives

- To evaluate the fresh yield of the six Egyptian and local Clover Varieties under the Nangarhar University Agronomic Research Farm, Nangarhar province conditions;
- To recommend the best performing clover variety for the Nangarhar University Agronomic Research Farm type conditions in Nangarhar Province;
- To demonstrate the forage best practices and train MAIL-Researchers, Nangarhar University faculty and students in forage varietal research;
- To produce a farmers’ field guide for farmers and extension agents about Egyptian clover best agricultural practices.

Egyptian and local clover forage varietal comparison trial results

Yield results of Egyptian and local clover forage varietal comparison trial obtained at the Agronomic Research Farm, Nangarhar University in Jalalabad in the growing season of 2010-2011 are displayed below in Table (18) and Figure (26 and 27).
Table 18. Total forage yield (MTon/ha) of the six tested Egyptian and local clover varieties as a percentage of the total accumulated yield obtained from three cuts at the Nangarhar University Agronomic Research Farm, Nangarhar Province in the growing season of 2010-2011

<table>
<thead>
<tr>
<th>Egyptian Clover Forage Variety</th>
<th>First Cut</th>
<th>Second Cut</th>
<th>Third Cut</th>
<th>Total of three cuts (MTon/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield (MTon/ha)</td>
<td>% of the total</td>
<td>Yield (MTon/ha)</td>
<td>% of the total</td>
</tr>
<tr>
<td>Hellaly</td>
<td>29.38 A, B</td>
<td>45.76</td>
<td>34.81 A, B</td>
<td>54.24</td>
</tr>
<tr>
<td>Sakha-4</td>
<td>31.88 B</td>
<td>38.93</td>
<td>50.00 A</td>
<td>61.07</td>
</tr>
<tr>
<td>Gemiza-1</td>
<td>26.31 A</td>
<td>41.93</td>
<td>36.44 B</td>
<td>58.07</td>
</tr>
<tr>
<td>Serw-1</td>
<td>28.06 B</td>
<td>40.88</td>
<td>40.50 A, B</td>
<td>59.12</td>
</tr>
<tr>
<td>Giza-6</td>
<td>24.06 B</td>
<td>35.78</td>
<td>43.19 A, B</td>
<td>64.22</td>
</tr>
<tr>
<td>Fahl</td>
<td>46.31 A</td>
<td>100.00</td>
<td>0.00 C</td>
<td>0.00</td>
</tr>
<tr>
<td>CV (%)</td>
<td>18.13</td>
<td>18.55</td>
<td>7.46</td>
<td>8.66</td>
</tr>
<tr>
<td>LSD (0.05) Bellaly</td>
<td>8.47</td>
<td>9.55</td>
<td>3.66</td>
<td>12.75</td>
</tr>
<tr>
<td>LSD (0.05) Sakha-4</td>
<td>11.58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Gemiza-1</td>
<td>10.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Serw-1</td>
<td>5.42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Giza-6</td>
<td>8.59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 26. Forage yield (MTon/ha) distribution per cut of the six tested Egyptian and local clover varieties obtained from three cuts at the Nangarhar University Agronomic Research Farm, Nangarhar Province in the growing season of 2010-2011
Figure 27. Total forage yield (MTon/ha) distribution of the six tested Egyptian and local clover varieties obtained from three cuts at the Nangarhar University Agronomic Research Farm, Nangarhar Province in the growing season of 2010-2011

![Bar chart showing total fresh clover forage yield at Nangarhar University Agricultural Research Farm Demonstration Plots, Nangarhar Province, 2010-2011.](chart)

**Practical implementation**

- Egyptian clover Sakha-4 variety had the highest significant total fresh forage yield with 124.5 tons per hectare from three cuts. The lowest total fresh forage yield was obtained by Gimeza-1 with total fresh forage yield of 96.9 tons per hectare.

- Fahl variety is a mono cut type of Egyptian clover. Therefore, Fahl produced the highest significant fresh forage yield per first cut; then it has disappeared in the second and third cuts.

**Recommendations**

- We do recommend registration, certification and multiplication of the proven introduced Egyptian clover Sakh-4 variety by the MAIL-seed system in order to distribute it nationwide as the potential winter forage legume, high yielding, and highly nutritional value crop for Afghan farmers and herders.

- We do recommend MAIL to contract National seed multiplication enterprises to produce the certified seeds of Egyptian clover Sakh-4 variety in order to be available for Afghan farmers and herders.
Kabul Province

In the 2010 growing season, the AWATT Forage Program established four applied forage research trials at the MAIL Badam-Bagh Research Farm and Agronomic Research Farm at the College of Agriculture, Kabul University.

Agronomic Research Farm, Kabul University, 2010

In June 2010, the AWATT Forage Program established applied forage research and demonstration programs at the Agronomic Research Farm, College of Agriculture, Kabul University.

Two applied forage research trials were carried out in cooperation with the College Dean, faculty members, and students at the Agronomic Research Farm on 4000 m²:

- Irrigation experiment to determine a proper irrigation schedule for Sudan grass;
- Forage crop varietal comparison experiment for pearl millet, Sudan grass, cowpea, sorghum and local forage Jawari.

Forage Crops Varietal Comparison Trial

**Experimental title:** Forage yield performance of pearl millet, sorghum/Sudan grass hybrid, cowpea, Sudan grass and local Jawari (yellow corn) under the Agronomic Research Farm, Kabul University, Kabul Province environmental conditions in Afghanistan.
Experimental objectives

- To evaluate the fresh yield of the five forage crops at the Agronomic Research Farm under Kabul University environmental conditions;
- To recommend the best performing forage crop for the Agronomic Research Farm under Kabul University type conditions in Kabul Province;
- To demonstrate and train faculty members and students in forage applied research;

Forage crops varietal comparison trial results

The results for fresh forage yield of five different summer forage crops: pearl millet, sudan grass, cowpea, sorghum, and local yellow corn (jawari) obtained at the College of Agriculture Agronomic Research Farm, Kabul University in the summer growing season of 2010 are displayed in Table (19 and 20) and Figure (28).

Table 19. Average fresh forage yields (MTon/ha) of five different summer forage crops: pearl millet, sudan grass, cowpea, sorghum, and local yellow corn (jawari) obtained at the College of Agriculture Agronomic Research Farm, Kabul University in the summer growing season of 2010

<table>
<thead>
<tr>
<th>NN</th>
<th>Station Name</th>
<th>Forage Crop</th>
<th>Cut</th>
<th>No of Replications</th>
<th>Average Fresh Yield Per Cut</th>
<th>St. Dev. Fresh Forage Yield</th>
<th>Range of Fresh Forage Yield</th>
<th>Total Fresh Forage Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kabul University</td>
<td>Yellow Corn (Jawari)</td>
<td>1</td>
<td>4</td>
<td>24.04</td>
<td>3.66</td>
<td>20.5 - 27.2</td>
<td>24.04</td>
</tr>
<tr>
<td>2</td>
<td>Kabul University</td>
<td>Sudan grass</td>
<td>1</td>
<td>4</td>
<td>30.53</td>
<td>10.83</td>
<td>19.1 - 45.0</td>
<td>57.40</td>
</tr>
<tr>
<td>3</td>
<td>Kabul University</td>
<td>Sudan grass</td>
<td>2</td>
<td>4</td>
<td>26.88</td>
<td>4.82</td>
<td>22.0 - 33.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Kabul University</td>
<td>Sorghum/Sudan Hybrid</td>
<td>1</td>
<td>4</td>
<td>26.06</td>
<td>8.82</td>
<td>17.7 - 38.5</td>
<td>51.69</td>
</tr>
<tr>
<td>5</td>
<td>Kabul University</td>
<td>Sorghum/Sudan Hybrid</td>
<td>2</td>
<td>4</td>
<td>25.63</td>
<td>0.95</td>
<td>25.0 - 27.0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Kabul University</td>
<td>Cowpea</td>
<td>1</td>
<td>4</td>
<td>7.24</td>
<td>2.01</td>
<td>4.8 - 9.2</td>
<td>14.31</td>
</tr>
<tr>
<td>7</td>
<td>Kabul University</td>
<td>Cowpea</td>
<td>2</td>
<td>4</td>
<td>7.08</td>
<td>1.02</td>
<td>6.3 - 8.1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Kabul University</td>
<td>Pearl Millet</td>
<td>1</td>
<td>4</td>
<td>26.33</td>
<td>10.61</td>
<td>15.1 - 40.6</td>
<td>55.50</td>
</tr>
<tr>
<td>9</td>
<td>Kabul University</td>
<td>Pearl Millet</td>
<td>2</td>
<td>4</td>
<td>28.88</td>
<td>7.20</td>
<td>21.5 - 38.5</td>
<td></td>
</tr>
</tbody>
</table>
Table 20. Total fresh forage yield (MTon/ha) of five tested forage crops as a percentage of the total accumulated yield obtained from two cuts at the College of Agriculture Agronomic Research Farm, Kabul University in the summer growing season of 2010

<table>
<thead>
<tr>
<th>Forage Crop</th>
<th>First Cut</th>
<th>Second Cut</th>
<th>Total of two cuts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield (MTon/ha)</td>
<td>% of the total</td>
<td>Yield (MTon/ha)</td>
</tr>
<tr>
<td>Yellow Corn (Jawari)</td>
<td>24.04 ^A</td>
<td>100.00</td>
<td>0.00 ^C</td>
</tr>
<tr>
<td>Sudan Grass</td>
<td>30.53 ^A</td>
<td>53.18</td>
<td>26.87 ^A</td>
</tr>
<tr>
<td>Sorghum</td>
<td>26.06 ^A</td>
<td>50.42</td>
<td>25.63 ^A</td>
</tr>
<tr>
<td>Cow Pea</td>
<td>7.24 ^A</td>
<td>50.57</td>
<td>7.07 ^B</td>
</tr>
<tr>
<td>Pearl Millet</td>
<td>26.62 ^A</td>
<td>47.96</td>
<td>28.88 ^A</td>
</tr>
<tr>
<td>CV (%)</td>
<td>31.53</td>
<td>21.75</td>
<td>26.06</td>
</tr>
<tr>
<td>LSD (0.05) Sudan Grass</td>
<td>11.12</td>
<td>5.93</td>
<td>16.30</td>
</tr>
<tr>
<td>LSD (0.05) Sorghum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Cow Pea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05) Pearl Millet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 28. Total fresh forage yields (MTon/ha) of five different summer forage crops: pearl millet, sudan grass, cowpea, sorghum, and local yellow corn (Jawari) obtained from two cuts at the College of Agriculture Agronomic Research Farm, Kabul University in the summer growing season of 2010

Summary of results

- The obtained number of cuts was two cuts per summer growing season that was partly due to the late plantation in July, 2010.
- The total fresh forage yields from two cuts per growing season were 57.4, 55.5, 51.7, 24.0, and 14.3 MTon/ha for Sudan grass, pearl millet, sorghum/Sudan grass hybrid, local yellow corn (Jawari), and cowpea respectively.
Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet, Sudan grass, and cowpea crops be registered and certified at the MAIL Seed System as new forage crops for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crop to be produced according to the new seed law of Afghanistan.
- As a forage legume with highly nutritional values, cowpea is usually used in mixtures with other forage grasses such as pearl millet and sudan grass. Therefore, it is highly recommended to be registered and certified as a newly forage legume.

Forage Foundation Seed Production

The main objectives of AWATT Forage Foundation Seed Production activities are to provide technical assistance and training to MAIL to improve MAIL’s staff skills and ability to plan, manage and implement the forage foundation seed production activities at the DAIL-land and farm levels, and in addition, to register and certify these improved forage crops in order to commercially produce and sell the seeds by local seed enterprises to Afghan farmers. Therefore, these genetic forage resources in terms of the improved forage varieties will be maintained and sustained in Afghanistan. To produce and maintain good quality and healthy standards for the starter seed material of the newly introduced improved forage varieties, the seed foundation program has multiplied the following: pearl millet, Sudan grass, cowpea, 3 range plants and fourwing saltbush at the seed production sites at MAIL and DAILs Research Stations in Balkh, Herat, Kabul, and Nangarhar provinces.

Balkh Province

Seed Production Activities in 2009

Forage foundation seed production

In 2009, a seed production program for the forage pearl millet crop was established by the AWATT Forage Technology Transfer Program in Balkh province parallel with the introduction of the crop to farmers through the on-farm demonstration plots and testing at the MAIL Dehdadi Agricultural Research station and Agronomic Research Farm at Balkh University in Balkh Province.

In June 2009, the first forage foundation seed production sites for pearl millet (Shandawel-1, open pollinated variety from Egypt), as newly introduced forage to Afghanistan, were established at three locations at the MAIL Dehdadi Agricultural Research Station and two
contracted farmers. 750 kg of pearl millet foundation seeds were produced in 2009 at these three seed production sites.

Pearl millet produced under AWATT guidance

In 2009 the AWATT Forage Program team established two large pearl millet seed production farm sites (4350 m² and 5,169 m²) in Chemtal and Balkh districts, Balkh province. Two contracted farmers, 1) Said Hashem farm in Chemtal district, and at 2) Aziz Khan farm in Balkh district produced 336 and 250 kg of pearl millet seed, variety Shandawel-1, introduced from Egypt, respectively. In addition to 164 Kg of Pearl millet foundation seed were produced from DAIL-Dehdadi Agricultural Research Station in Dehdadi district.

The AWATT Forage Program has provided gratis the following agricultural materials for the two seed production farm sites in Chemtal and Balkh districts:

- 200 kg of chemical fertilizer (UREA 46% N);
- 200 kg of chemical fertilizer (Phosphorous);
- Certified seeds of forage pearl millet;
- Training, guidance and technical assistances.

Pearl millet foundation seed produced by AWATT delivered to Eng. Kateb Shams, DAIL-Balkh Director in 2010
In 2009, a total of 750 kg of pearl millet foundation seeds have been produced by the AWATT Forage Program. Results of the pearl millet foundation seed production in Balkh province in the summer growing season of 2009 are displayed in Table (21) and Figure (29).

Table 21. Total pearl millet foundation seed yield (Kg) obtained in Balkh province in the summer growing season of 2009

<table>
<thead>
<tr>
<th>NN</th>
<th>Province</th>
<th>District</th>
<th>Farmer’s or facility’s name</th>
<th>Crop</th>
<th>Plot size (m²)</th>
<th>Total Seed Production (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Balkh</td>
<td>Balkh</td>
<td>Aziz Rahman</td>
<td>Pearl Millet</td>
<td>5,169.5</td>
<td>250.00</td>
</tr>
<tr>
<td>2</td>
<td>Balkh</td>
<td>Chemtal</td>
<td>Sayed Hashem</td>
<td>Pearl Millet</td>
<td>5,000</td>
<td>336.00</td>
</tr>
<tr>
<td>3</td>
<td>Balkh</td>
<td>Dehdadi</td>
<td>MAIL Dehdadi Research Station</td>
<td>Pearl Millet</td>
<td>2,550</td>
<td>164.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>Total Seed Production in Balk Province (Kg)</td>
<td>750.00</td>
<td></td>
</tr>
</tbody>
</table>

Figure 29. Total pearl millet foundation seed yield (Kg) obtained in Balkh province at three sites in the summer growing season of 2009

Note: These results reflect the soil characteristics and productivities in the three seed production sites. Where the worst soil was at DAIL-Dehdadi Research Station, followed by Chemtal and the best was in Balkh district.

Seed production at farmer-owned land

In 2009, the farmers collaborating with the AWATT Forage Program were able to produce their own pearl millet seeds to plant them in successive growing seasons. In the summer growing season of 2009, 165.7 kg of pearl millet seeds had been produced at twenty-nine forage on-farm demonstration plots at farmer-owned land in five districts of Balkh Province including Dehdadi, Chemtal, Nahr-e-Shahi, Khulm, and Balkh districts. The produced seeds have been
used by farmers in the next 2010 planting season. Results of the pearl millet seed production at farmer-owned land in 5 districts in Balkh province in 2009 are displayed in Table (22) and Figure (30).

**Table 22. Total pearl millet seed yield (Kg) obtained at 29 demonstration plots on farmer-owned land in 5 districts, Balkh province in the summer growing season of 2009**

<table>
<thead>
<tr>
<th>NN</th>
<th>Province</th>
<th>District</th>
<th>Number of Farmers</th>
<th>Crop</th>
<th>Plot size (m²)</th>
<th>Seed Production (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Balkh</td>
<td>Dehdadi</td>
<td>8</td>
<td>Pearl Millet</td>
<td>148-300</td>
<td>8.76</td>
</tr>
<tr>
<td>2</td>
<td>Balkh</td>
<td>Nahr-e-Shahi</td>
<td>5</td>
<td>Pearl Millet</td>
<td>50 - 250</td>
<td>5.86</td>
</tr>
<tr>
<td>3</td>
<td>Balkh</td>
<td>Chemtal</td>
<td>3</td>
<td>Pearl Millet</td>
<td>80 - 280</td>
<td>9.16</td>
</tr>
<tr>
<td>4</td>
<td>Balkh</td>
<td>Khulm</td>
<td>3</td>
<td>Pearl Millet</td>
<td>50 - 500</td>
<td>6.48</td>
</tr>
<tr>
<td>5</td>
<td>Balkh</td>
<td>Balkh</td>
<td>3</td>
<td>Pearl Millet</td>
<td>80 - 200</td>
<td>6.47</td>
</tr>
</tbody>
</table>

Average Seed Production per District in Balkh Province (Kg) 33.15
Total Seed Production in Balkh Province (Kg) 165.73

**Figure 30. Total pearl millet seed yield (Kg) obtained at 29 demonstration plots on farmer-owned land in 5 districts, Balkh province in the summer growing season of 2009**

**Note:** These results reflect the water availability and soil characteristics and productivities in the five seed production district. In general, the most productive land due to water availability and soil quality was in Dehdadi district. Whereas, Khulm is facing low water availability followed by Balkh, Chemtal and Nahr-e-Shahi districts.
Training in Seed Production Technology in 2009

The training of farmers and MAIL extension workers on how to produce high quality fresh forage pearl millet is also important for the development of the seed production industry in Afghanistan. In 2009, sixty farmers had been trained in seed production of pearl millet by the AWATT Forage Program team to ensure the sustainability of transferred forage technology in Afghanistan as the seed will continue to be produced beyond the AWATT program.

AWATT Forage Pearl Millet Seed Production Training and Establishment Site at Plaz Posh Village, Balkh District, Balkh Province on July 3rd, 2009. 12 women farmers, 10 farmers, MAIL extension workers, researchers, students, and the AWATT Forage team attended the hands-on training and establishment.

Farmers, MAIL extension workers and students were trained how to produce forage pearl millet seeds in furrows at Khulm and Balkh districts, Balkh Province in June 2009.
Farmers, MAIL extension workers and students were trained in fresh forage production of pearl millet at Khulm District and at the College of Agriculture, Balkh University in July 2009

Seed Production Activities in 2010

In 2010, 10 jeribs (2 ha) of cultivated lands had been received by the AWATT Forage Program from MAIL-Balkh province to continue the forage foundation of the pearl millet seed production program. This program has been planned to secure high quality forage foundation seeds of pearl millet, in addition to the newly introduced in 2010, Sudan grass and forage cowpea for the MAIL seed system for the registration, certification and multiplication for Afghan farmers.

Forage foundation seed production

750 kg of pearl millet foundation seeds were produced by AWATT Forage Program in Balkh province in 2009. These seeds will be used for the next year forage pearl millet program in 2010. These seeds were used for 1) further seed multiplication to be sustained as a foundation seed, 2) more testing and evaluation at MAIL-research stations and universities in north, east, west, and central Afghanistan, 3) more demonstration plots (501 forage demo plots) at farmer-owned land in over 7 provinces.

In the summer growing season of 2010, ten jeribs (two hectares) at the MAIL-Balkh Agricultural Land (MBAL) in Balkh District, Balkh Province were used to produce foundation seeds for pearl millet, Sudan grass, and cowpea. During the planting period in 2010, the seed production site had been prepared and planted: six jeribs – with pearl millet, three jeribs – Sudan grass and one jerib – cowpea.

In 2010, the following forage foundation seeds were produced at DAIL/Balkh in Balkh District: pearl millet - 543.0 kg, Sudan grass - 136.0 kg, cowpea - 32.0 kg. These results are presented in Figure (31) below.
The produced forage seeds will be delivered to the MAIL-Seed System in order to be registered and certified according to the Afghan seed law. Further testing might be necessary at the MAIL research station for cowpea and Sudan grass before registration and certification.

**Seed production at farmer-owned land**

Pearl millet seeds produced by farmers participating in the AWATT Forage Program had high germination percentages and a higher number of tillers than the mother seeds. Farmers readily accepted the introduction of pearl millet and expressed their willingness to replace the local Jawari (Yellow corn) with pearl millet.

Some farmers participating in the AWATT Forage Program have already prepared the seeds produced in 2010 for the next season.

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**Figure 11. Total yield (Kg) of foundation seed produced at MAIL -Balkh Agricultural Land, Balkh Province in the summer growing season of 2010**

Total Yield of Foundation Seed Produced at MAIL - Balkh Agricultural Land, Balkh Province in 2010

Seed Yield (Kg)

- Pearl Millet: 543
- Sudan Grass: 136
- Cow Pea: 32
The AWATT Forage team has been asked by a large number of farmers (150 of 300 farmers) to provide the pearl millet seeds for the next year, and they are ready to buy the seeds at the price of 100Afs/Kg.

In the summer growing season of 2010, a total of 1103.9 kg of pearl millet seeds had been produced at 141 forage on-farm demonstration plots at farmer-owned land in 14 districts in Balkh province: Balkh, Char Bolak, Chemtal, Dehdadi, Shortepa, Kaldar, Sholgara, Nahr-e-Shahi, Khulm, Marmul, Dawlatabad, Zareh, Charkent, and Keshendi.

The seeds produced in 2010 will be used by participating farmers in the next planting seasons. Results of the pearl millet seed production at farmer-owned land in 14 districts in Balkh province in 2010 are displayed in Table (23) and Figure (32).

Table 23. Total pearl millet seed yield (Kg) obtained at 141 demonstration plots in 14 districts, Balkh province in the summer growing season of 2010

<table>
<thead>
<tr>
<th>NN</th>
<th>Province</th>
<th>District</th>
<th>Number of Farmers</th>
<th>Crop</th>
<th>Plot size (m²)</th>
<th>Seed Production (Kg)</th>
<th>Average per Farmer</th>
<th>Total per District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Balkh</td>
<td>Khulm</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>5.65</td>
<td>56.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Balkh</td>
<td>Dehdadi</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>7.65</td>
<td>76.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Balkh</td>
<td>Kaldar</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>24.70</td>
<td>247.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Balkh</td>
<td>Keshendi</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>2.19</td>
<td>21.9</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Balkh</td>
<td>Chemtal</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>11.45</td>
<td>114.5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Balkh</td>
<td>Shortepa</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>12.64</td>
<td>126.4</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Balkh</td>
<td>Nahr-e-Shahi</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>5.85</td>
<td>58.5</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Balkh</td>
<td>Sholgara</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>7.02</td>
<td>70.2</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Balkh</td>
<td>Zareh</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>1.49</td>
<td>14.9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Balkh</td>
<td>Charkent</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>1.85</td>
<td>18.5</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Balkh</td>
<td>Dawlatabat</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>9.90</td>
<td>99.0</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Balkh</td>
<td>Char Bolak</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>8.41</td>
<td>84.1</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Balkh</td>
<td>Marmul</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>1.39</td>
<td>13.9</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Balkh</td>
<td>Balkh</td>
<td>10</td>
<td>Pearl Millet</td>
<td>250</td>
<td>10.20</td>
<td>102.0</td>
<td></td>
</tr>
</tbody>
</table>

Average Seed Production per District in Balkh Province (Kg) 78.85
Total Seed Production in Balk Province (Kg) 1103.9
Figure 32. Total pearl millet seed yield (Kg per plot size) obtained at 141 demonstration plots in 14 districts, Balkh province in the summer growing season of 2010.
Herat Province

Seed Production Activities in 2010

Forage foundation seed production

Sixteen Jeribs (3.2 hectares) at the MAIL-Herat Agricultural Research Station in Enjil district, Herat province were used in the summer growing season of 2010 to produce foundation seeds for pearl millet, Sudan grass, and cowpea. The land was provided to the AWATT Forage Program by MAIL in June 2010 to initiate forage foundation seed production.

The produced forage seeds will be delivered to the MAIL-Seed System in order to be registered and certified according to the Afghan seed law.

During the planting period in 2010, the 16 Jeribs seed production site had been prepared and planted: 7 Jeribs—with pearl millet, 7 Jeribs—Sudan grass and 2 Jeribs—cowpea.

During the 2010 growing season, the following forage foundation seeds were produced at the MAIL/Herat Agricultural Research Station in Enjil district: pearl millet -125.0 kg, sudan grass -120.0 kg, cowpea - 70.0 kg. These results are presented in Figure (33) below.

Figure 33. Total yield (Kg) of foundation seed produced at the MAIL-Herat Agricultural Research Farm, Herat province in the summer growing season of 2010
Kabul Province

Seed Production Activities in 2010

Forage foundation seed production

During the 2010 growing season, 550 kg of sudan grass and 297 kg of forage cowpea foundation seeds were produced at the MAIL Badam-Bagh Research Farm in Kabul City, Kabul Province. These results are presented in Figure (34) below.

Figure 34. Total yield (Kg) of foundation seed produced at the MAIL-Badam Bagh Agricultural Research farm, Kabul province in the summer growing season of 2010

The produced foundation seeds will be delivered by the AWATT Forage Program team to MAIL, where they will be registered and certified by the MAIL Seed System and multiplied by local seed enterprises.

Cowpea seed production field of Cream-1 variety from Egypt; cowpea pods are in the maturity stage at the MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010
Cowpea seeds were harvested by trained workers in plastic baskets and transferred from the field to the collective site at the MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010.

Sudan grass seeds were ready to be harvested at the MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010.

Pearl millet seeds were ready to be harvested at the MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010.
Total Yield of Forage Foundation Seed Produced in Afghanistan under the AWATT Forage Technology Transfer Program in 2010

MAIL/Herat Agricultural Research Station in Herat Province:

Pearl Millet 125 kg
Sudan Grass 120 kg
Cowpea 70 kg

MAIL/Badam Bagh Agricultural Research Station in Kabul Province:

Sudan Grass 550 kg
Cowpea 297 kg

MAIL/Balkh Agricultural Land in Balkh Province:

Pearl Millet 543 kg
Sudan Grass 136 kg
Cow Pea 32 kg

Total Pearl Millet 668 kg
Total Sudan Grass 806 kg
Total Cow Pea 399 kg
Grand Total 1,873 kg
CAPACITY BUILDING

The main objectives of AWATT Capacity Building activities are to provide technical assistance and training to MAIL to improve their skills and abilities to plan, manage and implement the national forage program activates at the district and farm levels. Sixty two MAIL extension workers in the seven selected provinces including Herat, Balkh, Parwan, Nangarhar, Kabul, Logar and Wardak received adequate training in outreach extension in forage, proper farm resource management, rangeland watershed rehabilitation and seed production, in addition to thirty one MAIL researchers and university faculty members, who received training in forage research. A significant number of training materials: forage fact sheet, manuals, farmers’ field guides and presentations have been produced for farmers and MAIL extension workers in Dari and Pashto describing the best agricultural practices, forage and seed production technologies for pearl millet, cowpea, and Egyptian clover as newly introduced forage crops as well as rangeland watershed rehabilitation practices.

Balkh Province

Forage On-Farm Training in 2009 - 2010

In 2009, throughout the establishment stage and up to the first cut of the forage on-farm demonstration plots, farmers were trained by the AWATT Forage Technology Transfer Program team in the best agricultural practices for pearl millet, sorghum/Sudan hybrid, and local Jawari forage production and pearl millet seed production.

This training included:

- Land preparation for pearl millet, sorghum/Sudan hybrid, and local Jawari;
- Method of applying fertilizer as well as type of fertilizer and rate applied;
- Planting method;
- Irrigation regime and number of irrigations;
- Methods of weed control;
- Plant thinning on pearl millet seed production plots;
- Method of harvesting pearl millet and sorghum/Sudan hybrid;
- Feeding methods for livestock;
- Pearl millet seed production methods.

Many farmers invited their neighbors, who were in attendance for the entire establishment phase of the demonstration plots and thus received hands-on training on summer forage technology transfer as well.

In 2009, 626 farmers were trained in forage production methods and another 60 farmers in seed production methods.
Table 24. Number of trained farmers, who have received hands-on training in the establishment of forage demo plots and pearl millet seed production in five districts of Balkh Province, in 2009

<table>
<thead>
<tr>
<th>District</th>
<th>Period of Training</th>
<th>Number of Trained Farmers</th>
<th>Total Trained Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>On-Farm Demo</td>
<td>Seed production</td>
</tr>
<tr>
<td>Dehdadi</td>
<td>June &amp; July, 2009</td>
<td>203</td>
<td>203</td>
</tr>
<tr>
<td>Khulm</td>
<td>June &amp; July, 2009</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Chemtal</td>
<td>June &amp; July, 2009</td>
<td>108</td>
<td>29</td>
</tr>
<tr>
<td>Balkh</td>
<td>June &amp; July, 2009</td>
<td>83</td>
<td>31</td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td>626</td>
<td>60</td>
</tr>
</tbody>
</table>

In June 2010, a field training program was initiated in 14 districts in Balkh Province, where 15 district extension workers and 141 local farmers from all districts had been trained in the following:

- Pearl millet establishment;
- Land preparation;
- Fertilization;
- Plantation;
- Irrigation, weed control;
- Fresh forage harvesting and management;
- Feeding system;
- Seed production.

Farmers cultivated their plots in cooperation with the MAIL-extension workers and the AWATT Forage Program team. The DAIL and AWATT Forage team worked closely with the farmers to monitor their progress and provide them guidance. The AWATT Forage team also worked closely with the DAIL extension workers to guide them and build their capacity to do their work effectively.

**Forage Field Days in 2009 - 2010**

In July 2009, eight forage field days were conducted by the AWATT Forage Technology Transfer Program in five districts in Balkh to showcase the pearl millet, Sorghum, and Yellow corn (Jawari) forage on-farm demonstrations and forage research trials.
426 farmers, 40 rural livestock women and 42 local extension agents attended the growing and harvesting stage during the eight field days; with a total attendance of 693 of farmers, extension agents, faculty members, students and MAIL-staff.

A total of 693 participants including 197 farmers who had not been extended formal invitations attended these field days. Just over 12 percent of attendees were women. Practical training for 693 farmers, extension agents, faculty, and students was provided in the harvesting of the first cut of pearl millet, Sorghum, and Yellow corn.

Table 25. Eight forage field days were carried out through July 18-23, 2009

<table>
<thead>
<tr>
<th>No</th>
<th>Date</th>
<th>District</th>
<th>Village</th>
<th>Farmer/Site</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7/18</td>
<td>Khulm</td>
<td>Ganda Baghat</td>
<td>Amir Khan, Farmer Leader</td>
<td>36</td>
</tr>
<tr>
<td>2</td>
<td>7/18</td>
<td>Khulm</td>
<td>Ganda Baghat</td>
<td>Amir Khan, Farmer Leader</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>7/19</td>
<td>Dehdadi</td>
<td>Baba Kona</td>
<td>Mohammed Hanif, Farmer Leader</td>
<td>86</td>
</tr>
<tr>
<td>4</td>
<td>7/19</td>
<td>Dehdadi</td>
<td>Posht-e-Baghe</td>
<td>MAIL Dehdadi Ag Research Station</td>
<td>86</td>
</tr>
<tr>
<td>5</td>
<td>7/20</td>
<td>Nahr-e-Shahi</td>
<td>Choghdak</td>
<td>Abdul Gafar, Farmer Leader</td>
<td>66</td>
</tr>
<tr>
<td>6</td>
<td>7/21</td>
<td>Balkh</td>
<td>Kata Khil</td>
<td>Sultan Bey Khan, Kuchi Leader</td>
<td>154</td>
</tr>
<tr>
<td>7</td>
<td>7/22</td>
<td>Chemtal</td>
<td>Mer Qassem</td>
<td>Alem Shah, Farmer Leader</td>
<td>69</td>
</tr>
<tr>
<td>8</td>
<td>7/23</td>
<td>Mazar-e-Sharif</td>
<td>Balkh University, College of Ag Agronomic Research Farm</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total:</td>
<td>693</td>
</tr>
</tbody>
</table>

Training field day at the demonstration plot in Chemtal District, July 2009
Training field day at the demonstration plot in Dehdadi District, July 2009

Training field day at the demonstration plot in Balkh District, July 2009

Training field day at the demonstration plot in Nahr-e-Shahi District, July 2009
In 2010, the AWATT Forage Technology Transfer Program team conducted a series of forage training field days at selected farms for farmers, MAIL extension workers, and local governmental officials as follows:

**Table 26. Training field days in Balkh province in August of 2010**

<table>
<thead>
<tr>
<th>Date (2010)</th>
<th>District</th>
<th># Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 5</td>
<td>Dehdadi</td>
<td>47</td>
</tr>
<tr>
<td>August 7</td>
<td>Char Bolak</td>
<td>49</td>
</tr>
<tr>
<td>August 8</td>
<td>Khulm</td>
<td>44</td>
</tr>
<tr>
<td>August 9</td>
<td>Sholgara</td>
<td>53</td>
</tr>
<tr>
<td>August 13</td>
<td>Nahr-e-Shahi</td>
<td>52</td>
</tr>
<tr>
<td>August 16</td>
<td>Dawlatabad</td>
<td>50</td>
</tr>
<tr>
<td>August 17</td>
<td>Shortepa</td>
<td>50</td>
</tr>
<tr>
<td>August 18</td>
<td>Kaldar</td>
<td>50</td>
</tr>
<tr>
<td>August 21</td>
<td>Chemtal</td>
<td>50</td>
</tr>
<tr>
<td>August 23</td>
<td>Keshendi</td>
<td>49</td>
</tr>
<tr>
<td>August 24</td>
<td>Marmul</td>
<td>49</td>
</tr>
<tr>
<td>Totals</td>
<td>11 Districts</td>
<td>543</td>
</tr>
</tbody>
</table>
Forage training field day in Dehdadi district

Forage training field day in Char Bolak district

Forage training field day in Khulm district
Forage training field day in Nahr-e-Shahi district

Forage training field day in Dowlatabad district

Forage training field day in Shortepa district
Forage training field day in Kaldar district

The main focus of these forage field days was on:

- The importance of animal husbandry in Afghanistan;
- The main problems of animal husbandry (lack of food) in Afghanistan;
- Introduction of the AWATT Forage program (2009-2010);
- What is pearl millet?
- Nutritional value of pearl millet by comparing with Jawari (yellow corn) and wheat straw;
- Land preparation and other field practices to be considered for production of pearl millet;
- Importance of cropping systems in agriculture and their effect on pearl millet;
- Visiting the plots and weighing fresh pearl millet by square meter, measuring the height of pearl millet in square meter.

One extension agent from each of the 14 districts of Balkh province had been trained by the forage team in seed bed preparation and data collection from demo plots.

Forage Gender Program in 2009

The AWATT Forage Program in cooperation with the MAIL extension system in Mazar and in the Khulm district organized a training field day for thirty rural household women farmers who were effectively involved in livestock production. The workshop was held at a local farm where a forage demonstration plot had been established in the Khulm district. The farm was ideal for this activity as a high mud wall surrounded the farm.

The AWATT Forage Technology Transfer Program team had previously trained two women as master trainers. In addition, the program invited two women professors from the Animal Nutrition Department at Balkh University to participate in the training.
The AWATT forage field day in Khulm District, July 2009

Thirty women attended the AWATT forage field day in the Khulm District, July 2009

The women participants received the following forage training:

- Pearl millet & Sorghum/Sudan hybrid production;
- The best agronomic practices to produce high quality fresh forage;
- Forage irrigation and harvesting techniques;
- Forage feeding system.

MAIL Dehdadi Agricultural Research Station

In 2009, the AWATT Forage Technology Transfer Program had accomplished at MAIL Dehdadi Agricultural Research Station the following:

Three national researchers at the Dehdadi Station have received the following on the job training: in principles of forage research, experimental design, data collection, applied fertilizer experimental treatment, varietal experiment, best agronomic forage practices and pearl millet seed production. These scientists have been responsible for applying treatments, applying agricultural practices, and collecting data in cooperation with the AWATT Forage Program Team.
Balkh University Agronomic Research Farm

In 2009, the AWATT Forage Technology Transfer Program had accomplished at the College of Agriculture Balkh University Research Farm the following:

The US-land grant system

The US-land grant system has been tested in Chemtal District as a model, in which Balkh University, MAIL extension workers and the AWATT Forage Program team have worked together in selecting, implementing, and monitoring 5 forage demo plots and a pearl millet seed production site in Chemtal. The results of this cooperation were very successful: Balkh University faculty members and students and MAIL extension agents have gained great experience in extension service and seed production.

Forage training program for faculty members

18 faculty members have been trained in forage research and extension at the College of Agriculture Balkh University Agronomic Research Farm.

They received the following training:
- Principals of forage research;
- Experimental design;
- Irrigation of forage crops;
- Extension methods;
- Strengthen the working relationship between MAIL and Balkh University on research & extension;

36 male and 13 female faculty members have been trained in forage extension activities at the forage on-farm demonstration plots in five Districts in Balkh Province, through their attendance at the forage field days.
AWATT Forage Training Workshop and Field Day at the College of Agriculture, Balkh University in Mazar-e-Sharif on July 23rd, 2009. 136 faculty members, students, MAIL extension workers, researchers, NGOs representatives, and the AWATT Forage team attended.

Forage training program for students

- Two student interns have been hired and trained in seed preparation and planting of the research trials and on-farm demo plots.
- Six female students from Balkh University have been employed with internships and trained in forage research methods. They were given the opportunity to carry out the forage research trial at the College of Agriculture Agronomic Research Farm.
- Seventy five males and seven females attended the forage research field days at the College of Agriculture and were trained in forage research.

Forage internship program

In 2009, the AWATT Forage program in cooperation with the Dean of the College of Agriculture at Balkh University established an internship training program for six female and two male senior and junior students from the College of Agriculture to participate in the establishment of the forage trial at the College of Agriculture Agronomic Research Farm.

The intern students at the College of Agriculture, Balkh University received the following training:

- Experimental site preparation;
- Lay out the experiment;
- Design the experiment;
- Preparation of the experimental seeds;
- Seeds planting;
- Irrigation of experimental plots;
- Fertilization the experiment;
- Harvesting the first cut;
- Conducting data collection.
Six female and two male undergraduate students from College of Ag at Balkh University had internship training opportunities in forage research demonstration and extension at AWATT Forage Program at the College of Agriculture, Balkh University in 2009.

The 8 intern students trained on layout forage applied research at the Agronomic Research Farm of College of Ag at Balkh University in 2009.

**Agricultural Vocational School in 2010**

On July 18, 2010 the AWATT Forage Program conducted a training workshop entitled “Fundamentals of Applied Agronomy” to improve the knowledge base of the students at the Balkh Agriculture and Veterinary Institute (BAVI) in Mazar-e-Sharif.
The training workshop included two PowerPoint presentations:

**Irrigation Scheduling:**
- Soil properties
- Soil, water, and plant relationships
- Type of crop and its sensitivity to drought stress
- Stage of crop development
- Climatic factors such as rainfall and temperature
- Irrigation scheduling

**Forage Technology:**
- Forage crop taxonomy and importance
- Importance of forage in the farming system
- Forage crop/animal interaction
- Forage legume soil and fertility relationship
- Animal nutrition
- Forage quality
- Forage crop irrigation systems
- Forage intercropping and forage mixtures
- Hay and silage production
- Forage seed production
- Forage extension

Sixty-two students and eight teachers from the Balkh Agriculture and Veterinary Institute were trained in land preparation for plantation through a field visit to the MAIL-AWATT Forage Seed Production Site in Balkh District, Balkh Province on July 19, 2010. The AWATT Forage Program provided the transportation and the refreshments to the students and their teachers.
The students and teachers received practical training in the following:

- Soil texture and structure
- Soil PH and associated problems
- Soil bed seed preparation
- Soil tillage
- Fertilization application
- Soil leveling
- Irrigation system and methods
- Plantation methods
- Forage seed production
- The importance of proper crop rotation
- Soil fertility build-up
- Dodder weeds life cycle, problems and how to control it.
Herat Province

Forage Field Days in 2010

During the summer growing season of 2010, several training field days were held by the AWATT Forage Program team at selected farms in Shindand and Enjil districts in Herat Province at the time of the first forage crop cut. Seventy one farmers and three extension workers from both districts were trained in the following:

- Pearl millet establishment;
- Land preparation;
- Fertilization;
- Plantation Irrigation, weed control;
- Fresh pearl millet forage harvesting and management;
- Feeding system;
- Pearl millet seed production.

Seventy one farmers and three extension workers were trained in Shindand and Enjil districts

MAIL-Herat Agricultural Research Station (MHARS), 2010

In 2010, three Afghan young researchers from MAIL-Herat Agricultural Research Station in Enjil district were selected and trained in forage applied research to carry out the forage research trials.

Herat University Agronomic Research Farm, 2010

Two lectures were delivered for faculty and students at College of Agriculture, Herat University on June 22 and June 26, 2010 titled “Forage Crops Technology” and “Principal of Rangeland Management”.

On July 8, 2010, 50 students from the College of Agriculture at Herat University were trained at the Agronomic Research Farm on the following:
• Land preparation;
• Soil tillage;
• Land leveling;
• Experimental layouts;
• Irrigation systems/servicing;
• Fertilizer applications.

On August 20, 2010, thirty students and two professors from the College of Agriculture at Herat University were provided a demonstration/training on fertilizer applications at the Herat University Agronomic Research Farm.

**Agricultural Vocational School, 2010**

In June 2010, the AWATT Forage Program provided a practical training program on the principles of agronomy and forage production for students and teachers at the Herat Agriculture and Veterinary Institute (HAVI).

On June 23, 2010, Dr. Hamdy Oushy, the AWATT Forage & Rangeland Specialist, delivered the first preparatory lecture on the principles of agronomy for 50 students from the Agronomy Department at the HAVI.

As the AWATT Forage Program’s research and demonstration activities advanced, a second round of practical training was delivered to HAVI students through their participation in several field visits to the AWATT research site at MHARS in Enjil district.

In July–September 2010, students from the Agronomy Department at HAVI were given training in agronomy through lectures and field visits to the AWATT research and seed production site at the MAIL-Herat Agricultural Research Station (MHARS).
On June 29, 2010, the AWATT Forage Team arranged the first practical agronomic training on the field to 43 male and 13 female students from the HAVI at the MHARS.

The students were adequately trained in the following:

- The roles of the field machinery system in land preparation.
- Function of field tractors.
- Function of wheat compound.
- Function of wheat semiautomatic threshold.
- Function of various blowing disks.
- Land preparation system as blowing;
- Leveling ;
- Fertilizer;
- Lay out the land for specific field crops;
- Irrigation system for field crops.

Parwan Province

Forage Field Days in 2010

During the 2010 growing period, the AWATT Forage Program team conducted a series of training field days at selected farms for farmers, MAIL and DAIL extension workers, and local government officials.

On August 29, 2010 a field day was held in Central Parwan with 50 participants. On September 26, 2010, a forage field day was held in Sayied Khel District; 65 farmers and DAIL extension workers from five selected districts in Parwan province attended the field day and have been trained in the following:
Pearl millet seed production:
- hands-on training in the process of pearl millet flowering;
- hands-on training in the process of pearl millet seed maturity.

Pearl millet forage field days in Parwan province in 2010

Pearl millet forage production:
- hands-on training in the optimal cutting height of pearl millet forage;
- practical demonstration of the pearl millet cutting optimal method;
- best agronomic practice in delivery of chemical fertilizer (urea) after every cut to maximize forage yield;
- practical estimation of pearl millet forage yield per jerib;
During the training, the farmers expressed their appreciation for the program and the forage flow over the summer season. Farmers reported that their cow milk production had increased in both quantity and quality, and the animals had also gained weight. All farmers who participated in the field day asked the DAIL Director of Parwan and the AWATT Program to extend the Forage Program for a second year.

Nangarhar Province

Forage Field Days in 2010

During the summer growing season of 2010, a series of training field days at selected farms for farmers, extension workers, and local governmental officials were conducted by the AWATT Forage Program team in Kama and Behsood districts in Nangarhar province:

- On August 15, 2010, a field day was held in Behsood district for the first cut of pearl millet forage, attended by approximately 40 people, including the Behsood District Governor, MAIL, USAID and AWATT representatives, university and agricultural vocational school students and teachers, and local farmers;
On August 22, 2010, a field day was held in Kama district with 50 participants;

Professors from the Nangarhar Agricultural University visited the AWATT Forage team in Balkh province on a study tour at the Kefayat Cattle Farm, where they learned about farm’s activities in milk production and processing. They also visited the AWATT pearl millet technology demonstration plots.

**Agribusiness Development Team (ADT) Training in 2010**

In 2010, the AWATT Forage Program provided the training to National Guard ADT/Missouri in Nangarhar Province on the following areas:

- Forage Resource Management (FRM).
- Forage Production and Management.
- Crop Rotation.
- Rangeland Watershed Rehabilitation.
Dr. Hamdy Oushy, AWATT Forage Program Leader delivers a lecture on Farm Resource Management to the US Military ADT/Nangarhar team at MAIL-Shishem Bagh Farm, Nangarhar province held on Dec, 2010.

Dr. Hamdy Oushy, AWATT Forage Program Leader delivers practical training on Farm Resource Management to the US Military ADT/Nangarhar team at MAIL-Shishem Bagh Farm, Nangarhar province on Dec, 2010.
**AWATT/ASAP Collaborative Work in Forage Technologies**

**Fodder Program**

*Mou was established between AWATT and ASAP in Fodder program at BBF in Kabul:*

A Memorandum of Understanding is made and entered into Effect in July, 2010 by and between Chemonics International Inc., Prime Contractor for the USAID Accelerating Sustainable Agriculture Program (ASAP), and NMSU/AWATT (Afghanistan Water and Technology Transfer) program. The objective of this Memorandum of Understanding is to establish at MAIL-Badam Bagh Agricultural Farm an alfalfa fodder and annual cover crop demonstration and research program.

AWATT shall be responsible for the following under this agreement:

1. Provide direction to BBF farm manager on plot design, seeding rates, irrigation timing and hours of irrigation, fertilization rates and timing, pesticides and rates for the IPM program to ensure a successful production of alfalfa, Pearl millet, Sudan grass, forage Cowpea and Egyptian clover.

2. Provide at least 30kg/Ha of viable alfalfa seed (preferably inoculated with Rhizobium) and seed for other annual cover crops at acceptable international rates/ha for the commercial demonstration of alfalfa/fodder production at BBF.

3. All design inputs for establishing the designated plots specifically irrigation system designs.

4. Establishing and implementing a training program for farmers, NGO’s, Students, MAIL/DAIL staff and other appropriate parties to participate in scheduled Field Day/Workshops.

5. Package the above mentioned field day training workshops into fact sheets and have them translated into Dari and Pashto for inclusion on the ASAP – Afghanistan Agriculture Knowledge Bank

6. Conduct appropriate trials of varieties of alfalfa and annual cover crops to be able to recommend to farmers the correct varieties to production alfalfa and annual cover crops.

Provide a demonstration program at MAIL-Badam Bagh Farm for field training farmers, MAIL/DAIL staff, NGOs, dairy organizations, and students in the establishment, production, harvesting, and processing of alfalfa and annual cover forage crops with the intent to develop small scale farmer to commercial scale alfalfa and other annual forage crops production capacity in Afghanistan.
Forage Foundation Seed Production

AWATT Forage Technology Transfer Program in collaboration with ASAP provide the technical assistances, certified forage seeds of Pearl millet (Shandauel-1 variety), Cowpea (Cream-1 variety) and Sudan grass (Giza-1 variety) in order to produce the forage foundation seeds of these forages at MAIL facilities at the Badam Bagh Agricultural Farm in Kabul in 2010. They produced a total of 847 Kg of Sudan grass and Cowpea. These seeds were delivered to MAIL for seed multiplication and to produce the certified seeds through several local seed production enterprises.
AWATT/ASAP forage Cowpea foundation seed production at the BBF in Kabul in 2010

Forage Preservation

AWATT and ASAP collaborate in forage preservation as hay and silage making at MAIL facilities at the Badam Bagh Agricultural Farm in Kabul in 2010. AWATT Forage Technology Transfer Program in collaboration with ASAP provided the necessary technical assistances, training and follows up in order to demonstrate and produce high quality hay and silage of fresh forage materials for alfalfa at the MAIL facilities in Badam Bagh Agricultural Farm in Kabul in 2010.

Alfalfa Hay Making

AWATT Technology Transfer Program developed a simple hay making technology for alfalfa haymaking, step-by-step in the “Oushy Hay House” (OHH), for small farming systems in Afghanistan. These demonstration and training hay house was established in MAIL-Badam Bagh Farm and at the Agronomic Research and Demonstration Farm in Kabul University.

AWATT/ASAP forage Cowpea foundation seed production at the BBF in Kabul in 2010

Step (1)

Step (2)
Alfalfa Silage Making

In June, 2010, AWATT forage technology Transfer Program in collaboration with the Accelerating Sustainable Agriculture Project (ASAP) established alfalfa silage making demonstration plot at MAIL-Badam Bagh Research Station in Kabul City. It was establish as a technical training site for herders, dairy farmers, and livestock producers in order to get hand-on training in silage forage preservation for the winter feed consumptions.

Silage Program Objectives:

- Transfer Silage Making Technology to the Afghan Stakeholders;
- Train Kabul Dairy Union Members on Silage Making;
- Train farmers to reserve the surplus summer forage as silage for winter usages;
- Train faculties, students and teachers on silage making as a new technology to secure high quality feeds in winter.
AWATT Technology Transfer Program demonstrated a simple silage making technology, step-by-step, for below ground alfalfa silage at MAIL-Badam Bagh Farm for small dairy farms and livestock producers in small farming systems in Afghanistan.

Below ground silage pit

Plastic lining for silage pit

Input of silage materials in silage pit (Alfalfa & Wheat)
Compaction of manual silage materials

Tractor compaction of silage materials

Covering of silage pit with plastic for anaerobic condition treatment
In October 6, 2010, Mr. Karl Eikenberry, the United States ambassador to Afghanistan visited the alfalfa silage site at MAIL-Shishem Bagh Research Station through the Ag-Fair.

Forage Irrigation Technology

Flexi Flume Enhanced Canal Irrigation System

AWATT forage technology Transfer Program in collaboration with the Accelerating Sustainable Agriculture Project (ASAP), in June 2010, designed and implemented the Flexi Flume enhanced canal irrigation system for forage flood irrigation demonstration plots at MAIL Badam Bagh Farm and Agronomic Research and Demonstration Farm t Kabul University. It was establish as a technical training site for farmers, dairy farms, herders, and livestock producers in order to get hand-on training in forage production and irrigation.
Flexi Flume was used to irrigate forage demonstration plot at Badam Bagh Farm in Kabul in 2010.

Flexi Flume was used to measure the water use in irrigated forage research trials at Badam Bagh Farm and Kabul University in Kabul, Afghanistan in 2010.

Flexi Flume was used to irrigate Pear millet, Sudan grass, and alfalfa demo plots at Kabul University in 2010.
Lessons Learned and Recommendations

All activities initiated by the AWATT Forage Technology Transfer Program in selected provinces in Afghanistan during the 2010 Spring season and presented in this Report are mainly aimed to achieve the sustainability of the forage and seed production system in Afghanistan and provide broad long-term assistance to the Afghanistan national and local government, MAIL and DAIL extension workers, farmers, and the faculty members and students from various Universities in Afghanistan to succeed in this process.

Among these AWATT Forage Program activities are an establishment of a significant number of demonstration plots, introducing the Pearl Millet as a major and the most potential forage crop, establishing of the Forage foundation seed production, introducing a number of the most efficient forage technologies and irrigation systems, building a capacity among the MAIL and DAIL extension workers, farmers, and the faculty members and students from different Universities.
During the process of the development of the Afghanistan forage production system, the AWATT Forage Program Team learned important lessons that were valuable for the future projects activities and should be considered by the other international aid programs in Afghanistan.

These lessons include the following:

- On-farm demonstrations, field days and workshops showed that farmers would like to learn more about the forage, seed production, and hay production, silage making, feeding system as well as to improve their practical agronomic knowledge on land preparation, fertilizer application, irrigation, and plantation, forage harvesting, and seed production.
- Farmers also have a very positive attitude toward adoption of new agronomic and forage production technologies that will be beneficial to farmers and their families and will increase their income, and reduce the use of time or labor.
- No national forage research and extension program exists within the MAIL system to improve forage and seed production and there is no single seed company involved in producing improved forage seed in Afghanistan.
- Developing a strong relationship with national, local government, business companies, farmers, extension agents, PRTs, and other international donors and programs is an important part of the AWATT Forage Program activities to successfully achieve the Program objectives in Afghanistan.
- Creating the opportunities for the MAIL and DAIL extension workers, students and faculty members from different universities to participate in the AWATT Forage Program activities is substantial for the process of capacity building in agronomy and forage crop production process and building the basis for the future development of Afghanistan agriculture.
- Expanding the AWATT Forage Program activities from 7 selected provinces to other provinces in Afghanistan is highly desirable for the development of a sustainable forage and seed production system nationwide.
- There is much potential and room to improve the overall agricultural production in Afghanistan with low cost interventions.

As a result of the AWATT Forage Technology Transfer Program activities in Afghanistan in 2009-2011, there are few important recommendations for future activities that have been identified as the following:

- A new National Afghan “Forage Research & Extension” Program should be developed based upon the well-established solid foundation base of the AWATT forage program in Afghanistan.

The produced foundation seeds of the improved forage crop varieties of pearl millet, sudan grass and cowpea introduced to Afghanistan by AWATT, should be registered, certified by the
MAIL seed system and then turned over to the local private seed enterprises for commercial multiplication for the Afghan farmers.

The developed forage fact sheet training materials in English, Dari and Pashto should be disseminated and distributed for the MAIL extension workers and researchers, faculty members and students as well as the vocational school teachers and students in order to improve their capacity in forage technology transfer.
ACKNOWLEDGEMENTS

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Special thanks should be given to Col. Michael D. Fortune, Nangarhar ADT IV Commanding and his team for his sincere cooperation and support for all our efforts to help Afghan people to improve their agricultural system and production.

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- Hamdy Oushy