Seed Security in Badakshan, Afghanistan

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Abstract

Badakshan is located in the extreme northeastern corner of Afghanistan and has not yet come under Taliban control. The province is virtually cut off from the rest of the country and is traditionally food deficient. The 20-year-old conflict in the region has further aggravated the situation, causing massive population displacement and almost complete destruction of civil institutions and infrastructure. The situation has become so serious that food aid has to be distributed in the period of grain deficit, starting from before the harvest. Simultaneously, efforts are being made to rehabilitate and improve the agricultural systems of these farming communities.

In all formal and informal surveys in the area over the last three years, the farmers have identified good seed of wheat cultivars and fertilizer as being their main priority. Currently the seed of high-yielding cultivars acquired from the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) are available, but such varieties do not always perform well under farmer's conditions. The potential of these varieties can not be realized without the use of fertilizers. Almost all the available animal dung is used to as fuel and little is available for use as manure. The small amounts of chemical fertilizer available are totally inadequate in quantity and exorbitant in price. In response to these needs, improved varieties of wheat, potatoes, and vegetables are being provided to over 100 villages in five isolated districts bordering Tajikistan. Three to eight farmers in each village are testing the new planting materials under their local conditions. These farmer-led, on-farm evaluations are also serving as demonstration plots for the remainder of the farmers in the village. The farmers will compare the performance of the varieties provided with their existing varieties. Cultivation of the better of the two will be encouraged through farmer-to-farmer exchanges and credit through village organizations for the inputs. This procedure will be repeated every growing season whenever new potential materials, including varieties, landraces, and different crop species are available. A secondary goal is to enhance on-farm genetic diversity among and within different crop species. These activities will be gradually transformed into participatory breeding, allowing the community to gain full control over the type and amount of varieties being produced and exchanged with their neighbors. Participation in the management and decision making for seed security by the farming community will contribute to reestablishing local food security and peace in the area.

Introduction

Focus Humanitarian Assistance (FOCUS) is an international group of agencies established in Europe, North America, and South Asia to complement the provision of emergency relief, principally in the developing world. It helps people in need reduce their dependency on humanitarian aid and facilitates their transition to sustainable, self-reliant, long-term development. FOCUS is affiliated with the Aga Khan Development Network, a group of institutions working to improve opportunities and living conditions for people of all faiths and origins in specific regions of the developing world. Underlying the establishment of FOCUS by the Ismaili Muslim community is a history of successful initiatives to assist people struck by natural and man-made disasters in South and Central Asia, and Africa.

Assisting farmers in disaster situations to restore agricultural systems was identified as a priority in the Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture. The plan was adopted by over 150 countries at the International Technical Conference on Plant Genetic Resources (Leipzig, Germany, June 1996). The conference

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recognized that disasters, civil strife, and war pose challenges to agricultural systems. Often, adapted crop varieties are lost and cannot be recuperated locally. Food aid, combined with the importation of often poorly adapted seed varieties, can undermine food security and increase the costs of donor assistance. In such situations, the goal is to deliver seed of adapted varieties and landraces as needed to help reestablish indigenous agricultural systems in areas affected by disaster. In turn, this can play a major role in restoring local food security.

Afghanistan

Afghanistan is one of the poorest countries in the world. This millenium, the country passed the mark of 21 years of conflict, which has brought complete destruction and immense suffering to its people. After the fall of the Soviet-backed government in 1992, the prospects for peace have receded, with continuing civil war fragmenting the country into struggles between the various political and military groups in shifting alliances. Currently, more than 80% of the country is under the Taliban, while the remainder is under a united front. However, the Taliban movement is not yet recognized by the international community, except for Pakistan, Saudi Arabia, and the United Arab Emirates.

The nation's agricultural system has suffered from physical damage to irrigation structures, from mines, and from the disruption of normal markets and input-delivery mechanisms. Security concerns, high transport prices, and continual currency depreciation all combine to cause shortages of agricultural inputs such as seeds, fertilizers, chemicals, credit, and labor, resulting in increased food scarcity. The civil unrest has caused the country to move from near self-sufficiency in the mid-1970s to a dependency on imports in recent years.

Badakhshan

Badakshan, one of the most remote areas in Afghanistan, is located in the northeastern corner bordering Kunar, Lagham, Kapisa, and Thakar provinces. In addition, the province borders Pakistan in the southeast, China in the east, and Tajikistan in the north. It is one of the two major areas not under the control of the Taliban. The Panj River (Amu Darya) separates its long border with Tajikistan. The province is normally linked with the rest of country a by narrow, drivable road through the province of Takhar on the West. Currently, after Takhar the road intercepts the frontline with the Taliban. The province is thus virtually cut off from the rest of the country. On the eastern side, the road is linked with the Gorno-Badakshan province of Tajikistan through a narrow bridge over the Panj River at Ishkashem.

Badakshan lies in the Hindu Kush mountain range with the Wakhan rising up into the Pamir Mountains. The Hindu Kush mountain system is characterized by young, rugged ranges with sharp peaks and deep valleys. The eastern half of the province lies between 1,300 meters (Darwaz) to 3,000 meters (Wakhan). The western half is at a lower elevation, with Keshem, the lowest point, at 960 meters. Inside the province, most of the districts are isolated from each other for a greater part of the year by heavy snowfall in the winter, landslides in spring, and floods in the summer. Because of the rugged mountain terrain, much of the land area is uninhabitable. Connecting dirt roads are either very rough or do not exist. Donkeys, horses, and walking constitute the major means of transport. It is common for villagers to walk three to four days to the nearest market. There is virtually no effective government operating in the province at the current time. The villages and larger towns in

the province have no electricity, no running water, no sanitation facilities, few medical facilities, and poor schools.

Badakshan province has historically been isolated and neglected. It has always been considered a poor province; even before the war, local agricultural production met only 50% of the needs. The few development initiatives ever started were abandoned after the communist takeover and the subsequent fight between the Taliban and the Northern Alliance. It is estimated that agricultural production is down by at least 40% as a result of the war (UNIDATA 1966).

Agriculture

The province has a highly diversified cropping system. Crop production, horticulture, and livestock are the main sources of income for most households. It is difficult to obtain reliable statistics on agricultural production. Figures on land holdings provided by farmers during interviews tend to be grossly underestimated for fear of government taxation and to qualify for humanitarian assistance. The majority of households own less than one hectare, and further fragmentation of land holdings occurs because of the traditional inheritance laws. Smaller farmers usually sharecrop the land owned by farmers with relatively larger holdings (more than two hectares). Many districts do not produce enough food, for example, surveys have shown that food deficits in Sheghnan, Ishkashem, and Wakhan range from two to six months.

Autumn and spring wheat is the main grain crop. Other crops include pulses (broad beans, vetches, field peas, grass peas) often grown as a companion crop with spring barley. Finger millet and chick-peas are also planted in spring. Small quantities of oil-seed crops such as sesame and flax are occasionally grown for oil, but the wild mustard that grows as a weed in the wheat fields is harvested by women and children for oil and cooking. Maize is grown at lower elevations (below 1600 m) from Darwaz through Shekay as a second crop after wheat. Cotton is also grown in small quantities in some villages from Darwaz downstream, where it is used for stuffing quilts and pillows, and the oil extracted from the seed is used for lamps.

Vegetables include spinach, onions, beans, occasionally tomatoes, carrots, squash, and a variety of herbs. Several kinds of potatoes of varying lengths of maturity are grown. These vegetables provide a supplementary diet during the hungry months of spring and early summer before the harvest. Fruit trees, particularly mulberries, are important. Other common trees include fruit trees such as walnut, apricot, plum, sour cherry, apple, and grape, and timber trees such as poplar, willow, and walnut. Several wild plants play an important role and include wild mustard, wild rhubarb, wild orchid tuber, black cumin, licorice, and mushrooms, in addition to the wild herbs of medicinal value. Opium poppy is not cultivated on a commercial basis, although small patches may be planted by addicts for their own use.

Livestock are a main source of the household economy in rural areas. The sale of livestock is the primary means for much of the population to earn income for purchase of other food and essential items, especially wheat, during the spring months when they run out of food stock. The province has huge common grazing areas that support herds of livestock belonging to the local people as well as to nomads.

Humanitarian assistance

The chronic food-deficit situation in the province results in a cycle of poverty leading to hunger, and hunger leading to even greater poverty, which is very difficult to reverse. Because of its remoteness, very few assistance agencies are able to work in the province.

In response to the food deficit in the region, FOCUS is implementing a relief program. The program has included the distribution of 10,000 tons of food aid to 250,000 people over the last years. Food rations were provided for every household in about half of the province. In some districts, food was provided in a food-for-work program. FOCUS is able to carry out its activities in Badakshan for several reasons: FOCUS is affiliated with the Aga Khan Development Network, which has been active in Tajikistan and Pakistan on the northern and southern borders of Badakshan. During the last three years, good working relationships have been established with local leaders and with international organizations. A participatory model for rehabilitation comprising situation assessment, health, food assistance, village organization, agriculture, physical infrastructure, education, and economic initiatives is being considered.

Agricultural interventions

Agricultural interventions by FOCUS have been initiated this year in the districts along the Panj River (Darwaz, Sheghnan, Ishkashem, Zebak, and Wakhan). Although Zebak is not strictly along the river basin, its farming systems resemble those of Ishkashem. These districts are among the most food-deficient areas in the province. FOCUS is able to access these areas across the river from Gorno-Badakshan in Tajikistan where the Aga Khan Development Network has a comprehensive development program, of which agriculture is an important component.

The populated areas of the Sheghnan, Ishkashem, Wakhan, and Zebak districts are at an altitude of 2200 to 3000 meters. Population densities are low. Although there is a comparatively large area of land per capita, low temperatures, short growing seasons, low rainfall, and poor soils combine to lower productivity. Darwaz, on the other hand, is at a lower altitude (minimum 1300 meters) and has a longer growing season with higher rainfall and temperatures.

Table 1. Characteristics of the Target Areas

	Ishkashem	Zebak	Wakhan	Sheghnan	Darwaz
Number of villages	30	14	16	17	54
Households (farms) per village	39	45	68	160	132
People per household	9.0	9.3	8.7	8.3	8.7
Land resources: ser* per household	21	11	25	12	6
Number of animals per household	15	10	12	14	6
Number of households surveyed	1200	635	1084	2555	2648

* A *ser* is a local measure of land area based on seeding rate, ranging from 20 to 35 *sers* of wheat seed per hectare.

Needs assessment

Only 2% of eastern Badakshan is suitable for agriculture, and its soil quality is often poor and deficient in nutrients. A large portion of the agriculture is based on irrigation from rivers and torrents. Extensive systems of irrigation channels have been developed by the communities over centuries, bringing water long distances along the mountainsides. There is also a considerable amount of farming that depends on moisture from rainfall and melting snow, which is less productive.

The general constraints on crop and livestock production in the area include the following:

- lack of access to good, pure seed for cereal crops
- lack and/or cost of inputs such as fertilizers and plant-protection materials
- diseases, pests, and weeds
- lack of irrigation water and the state of the water system
- remoteness of markets and lack of transport facilities
- lack of agricultural and livestock services
- taxes (generally as a part of their crop yield)
- displacement of technical staff and farmers and destruction of institutions

In all formal and informal agricultural surveys, the farmers' priorities have always been fertilizers and good seed of improved varieties. Most farmers are aware of the possibilities of increasing their production through these inputs, especially fertilizers. The soil is generally very shallow and lacks sufficient nutrients to support intensive crop production. With shortages of fuel, especially firewood, most of the available animal dung is used for cooking and for heating in winter. The population of trees remaining is barely sufficient for watershed purposes and needs to be replenished. Lack of sufficient fodder for feeding livestock during the winter also limits the amount of animal dung available for the household. Small amounts of fertilizers are sometimes available in the markets but are usually of poor quality and very costly. Most farmers lack resources at planting time and have to pay high interest to borrow money for purchasing small amounts of fertilizer against the expected harvest.

The attitude of farmers towards weeds is rather tolerant, as many are also seen as serving a useful purpose. At a certain level, weeds in the wheat are considered to improve the quality of the straw as fodder. The presence of some wild rye is said to improve the quality of bread. Wild mustard is harvested separately by the women and processed for lamp and cooking oil. Some families consume plants of edible species weeded in the fields, such as *Chenopodium* spp.

Wheat is a staple food in all the communities of eastern Badakshan and is grown on both irrigated and rain-fed land. Altitude and snow cover tends to dictate whether wheat is sown as a spring or an autumn crop. Wakhan, Ishkashem, Zebak, and southern Sheghnan grow mostly spring wheat, while northern Sheghnan and Darwaz grow winter wheat.

Overall, wheat yields per hectare vary from 0.5 to 2.0 tons under irrigation and from 0.3 to 0.7 tons in rain-fed areas. The yields vary enormously with location, altitude, soil quality, the availability of farmyard manure (chemical fertilizer in the area is a rarity), susceptibility to fungal diseases such as rust and smut, pests such as locusts, weeds, and the genetic origin and purity of the seed planted.

Little or no introduction of improved varieties had taken place in eastern Badakshan prior to 1979. AfghanAid has recently established demonstration plots of improved varieties from the Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT) as part of an integrated development program in Badakhshan, including the districts of Ishkashem and Zebak. Almost all farmers grow a number landraces that are of local origin and of very mixed appearance, often heavily infested with weeds, particularly wild wheat, wild oats and mustard. *Sorkhak,* an indigenous red-grained wheat, is generally planted in the autumn, while safidak, an amber/light-grained wheat, is planted in the spring. A few farmers have part of their fields under seed from other districts, including from Pakistan and Tajikistan. Some of this is of improved origin but by now very mixed with other varieties and weeds.

In Darwaz, different types of wheat are cultivated with different lengths of straw, some with awns and some awnless. Winter-wheat types clearly owe their origin to Russian varieties and to the facultative varieties introduced elsewhere in the province under various United Nation and aid programs. Local cultivars are almost exclusively sown on rain-fed land.

Participatory seed-security strategy

Seed security (farmers' access to adequate, good-quality seed of the desired type at the right time) is the first defense for food security (the access by all people at all times to enough food to maintain an active and healthy life). This is especially true for war-torn Afghanistan in general and for neglected Badakhshan in particular. As recognized at the World Food Summit held in Rome (FAO 1996), poverty and impoverishment precondition people to a state of vulnerability—vulnerable to life-cycle hunger, vulnerable to seasonal hunger, and vulnerable to the impact of disaster. This also describes the state of food security today in eastern Badakshan.

The loss of access to seeds and food are often interconnected. While seeds are crucial to agricultural recovery, human energy is equally important. Seed relief is being viewed as an integral part of the emergency package. There are several examples from other parts of the world that show that the action taken to restore seed security quickly after disaster is an effective way to help restore food security in an area. During the 1991/92 drought in Southern Africa, an emergency seed-production project, jointly coordinated by the Southern African Development Community (SADC) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), was highly successful compared to the projects in which seed was imported. Their success was due to the distribution of better-quality adapted varieties. The Seeds of Hope initiative helped rebuild domestic food security through the rehabilitation of seed security following the civil war in Rwanda in 1994. Adapted varieties and landraces were assembled and multiplied in neighboring countries and reintroduced into Rwanda.

The seed program aims to ensure availability of the right kind of seed in the right place. Adapted varieties are obtained from similar agroclimatic conditions in Tajikistan and delivered across the Panj River to several distribution points. Transportation within Afghanistan is mostly by volunteers, by donkeys made available by the communities for this purpose. This helps to keep the costs of introducing the varieties to a minimum. The amounts being distributed have been minimized to enable the local seed-production and -distribution systems to continue functioning smoothly.

Early in spring of this year, seeds of high-yielding varieties of wheat, maize, other cereals, potatoes, and vegetables appropriate to the agroecological conditions of the area were introduced through

on-farm, farmer-managed observation sites in the target districts. All the villages in the Wakhan, Ishkashem, Zebak, Sheghnan, and Darwaz districts are participating. The farmers are selected through village committees, traditionally known as *shuras*. Attempts are being made to involve as many different farmers as possible by restricting the distribution of only one kind of crop commodity to each participating farmer.

Initially, for each kind of crop, varieties that are widely adapted and available in sufficient quantity are being introduced. This will be followed by varieties and landraces with superior traits such as higher yield, better adaptability, improved disease and pest resistance and stress tolerance, and more consumer acceptability. In future, different kinds of lentils, forages, fruit and timber trees, and herbs of medicinal value will also be introduced into the farming systems. It is expected that the introduction of useful germplasm will be repeated every growing season whenever new potential materials are available and the farmers—through their village committees—are in favor of it. Rather than replacing existing germplasm, the goal is to increase the range of germplasm available on-farm. This will contribute to enhancing on-farm genetic diversity among and within different crop species.

The emphasis is on farmer and community empowerment. Participating farmers and their neighbors will judge the usefulness of the materials being introduced and their subsequent multiplication and distribution. Farmer-to-farmer seed exchange forms the basis of the local seed system in the region. It is a part of the local culture that anyone with seed of improved varieties is obliged to share the seed produced at the first harvest with his extended family. Such acts of cooperation reinforce family ties with distant blood relatives. In some cases, extra amounts of seed will be distributed on credit if the demand for the varieties introduced cannot be met by the local seed systems. Credit systems in which farmers pay for the inputs at harvest are also being used for supplying fertilizers.

These activities will be gradually transformed into participatory breeding, allowing the community to gain full control over the type and amount of varieties being produced and exchanged with their neighbors. Participation in the management and decision making for seed security by the farming community will contribute to reestablishing local food security and peace in the area.

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Involving Farmers in the Development Process to Improve Adoption of Varieties Developed by National Maize-Breeding Programs

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Abstract

Developing maize varieties that will be readily adopted by subsistence farmers is challenging as there are numerous characteristics in addition to agronomic performance that are important to these farmers. Furthermore, these preferences vary from location to location. It may be logical to conclude that because of these location-specific requirements, maize breeding that targets subsistence farmers should be done at a localized level. National maize-improvement programs have an important role to play in developing improved maize genotypes for these farmers because they have access to a wide range of genetic materials that allows for the identification of genes for disease resistance and high yield that may not be available in local germplasm. Furthermore, they have the expertise required to incorporate these genes efficiently into genotypes that meet the farmers' other requirements. To increase the impact of genotypes developed by national maize-improvement programs, however, farmer input into their activities is essential. A balance between on-station breeding activities and interactions with farmers is needed in order for the process to be efficient. Therefore, the National Maize Research Program within Nepal's National Agricultural Council (NARC) has developed the following procedures for developing maize genotypes for subsistence farmers with their input. First, through on-farm surveys, the required grain (i.e., flint, dent, yellow, or white) and plant (i.e., tall, leafy, early, or late, etc.) types are determined. Second, exotic and locally developed genotypes are screened for the desired characteristics and general adaptation on-station using local varieties from the targeted environment as checks to ensure that maturity duration matches that already used by farmers. Promising materials are initially tested on-station for yield and disease resistance. Elite materials (approximately six to eight genotypes) are then tested in on-farm trials under farmers' conditions. Farmers who grow these materials observe their agronomic performance and provide input about which entries they prefer. Only those varieties that have proven to be high yielding and stable, and which have the characteristics preferred by farmers, will be released and made available on a more national scale. Maintenance of released genotypes and seed multiplication is a resource-intensive activity that must be limited to genotypes that are the most likely to have an impact. We believe that this varietal-development scheme will efficiently provide new and desirable options to small-scale subsistence maize farmers in Nepal.

Introduction

Maize is one of the three most important cereal crops in the world. Global annual maize production now exceeds 550 million tons. Of that, approximately 100 million tons are used directly for human food (CIMMYT 1999). Maize is growing in importance in Asia, primarily as a feed for animals. Nevertheless, there are significant areas of the region where maize is still the dominant cereal in the human diet. In Nepal, for example, of the 1.4 million tons produced annually, it is estimated that 86% is used directly as human food (CIMMYT 1999). The development of hybrids is one of the main reasons for the phenomenal advances in maize productivity throughout the world in the past few decades. In most developed countries, the area planted to hybrids approaches 100% of all land planted to corn. Growth in the use of hybrids has been impressive in areas of the developing world as well. For example, 60% and 46% of the area planted to maize is sown to hybrids in Thailand and

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Vietnam, respectively. Both within Asia and globally, there is a significant negative correlation between the percent utilization of maize for human food and the use of improved varieties (CIMMYT 1999). This can partially be explained by the fact that subsistence farmers have limited cash and are reluctant to pay the premium price associated with improved seeds, particularly hybrid seed, which must be purchased each year. Single-cross hybrid seed in Asia costs on average US $3.12 per kg, in comparison to US $0.69 per kg for open-pollinated varieties (OPVs) (Gerpacio 1999).

The development of OPVs for areas of the world where maize is grown as a subsistence crop makes good sense. Compared to hybrids, OPV seed is more readily produced, it can be made available to farmers at a lower cost, and it can be generated by farmers themselves. Nevertheless, in large areas of the world where maize is a subsistence food crop, a large percentage of the area is not planted to improved varieties (OPVs or hybrids) even though modern varieties with excellent adaptation are available from both the public and private sectors. The poor adoption of improved maize varieties can be attributed to many factors, primary among which may be the lack of viable seed enterprises. Other factors, such as the varieties' lacking the characteristics that are important to farmers, also constrain adoption. Farmers in Nepal for example, prefer their own varieties because they are earlier, have better husk cover and culinary characteristics than improved OPVs. In order to improve adoption of modern varieties, there is a need for greater farmer input into the development of genotypes that take these preferences into account. This paper discusses issues relative to developing and providing improved maize genotypes to farmers and describes a germplasm-improvement scheme adopted by the National Maize Research Program in Nepal to ensure that the products they develop are better targeted to the requirements of farmers.

Fixing favorable alleles—the numbers game

Maize is cross-pollinated under normal circumstances. Therefore, a crop or plot of a desired genotype must be carefully managed if the seed it produces is to be genetically pure. Furthermore, in relation to participatory approaches to plant breeding it means that seed of genotypes that are tested or demonstrated in farmers' fields in a typical small plot are likely to be contaminated or genetically altered through the inflow of foreign pollen. Saved seed will, therefore, not produce a phenotype identical to that observed the previous season. In a varietal-improvement program, be it through informal farmer selection or through a formally organized plant-breeding program, success is determined by the ability of the breeder to find desirable characteristics and fix them in the population so that they can be expressed in subsequent generations. For traits that do not exist or that have little expression in an otherwise desirable population, conventional breeding programs have a substantial competitive advantage over farmer-led approaches. In order to find favorable alleles for stress tolerance, for example, many thousands of lines and populations might need to be screened in order to identify a few genotypes with the desired characteristics. Similarly, for alleles that are found in a very low frequency in a population, breeding techniques that include selfing and extensive testing with recombination of best lines can be used to increase their expression relatively quickly.

Developing OPVs through conventional methods requires both time and land resources. As an example, the following steps are required to develop a superior experimental variety using full-sibs developed from an improved population (which itself may have been improved through many cycles of selection). First, 250 full-sib progenies are generated by hand-pollination. These are tested in up to six locations, including sites where a stress of interest is present. Next, eight to 10