

Agricultural Development in the Arid Mountains of Pakistan: the NADRI Approach

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Introduction

Mountain areas constitute 60 to 65 per cent of Pakistan's total area. These mountainous zones may be divided into two categories, arid mountains and wet mountains. The arid mountains can be further classified into two geographical sub-divisions: northern dry mountains and western dry mountains.

In the northern dry mountains, the topography is dominated by mountains (34%) and rangeland (52%), with a small area of natural forest (4%). Less than 1% of the land is cultivated (Archer 1992). In the western dry mountains, of which Balochistan is the best example, rangeland accounts for 93% of the total area. Vegetation is divided between shrublands in the south and grasslands in the north.

The National Aridland Development and Research Institute (NADRI) is pursuing two separate integrated models for agricultural development and social uplift of marginalised communities in the arid mountains of Pakistan. They are (a) the NADRI model and (b) the seabuckthorn model. This paper explains the various activities of both models.

National Aridland Development and Research Institute (NADRI) Model

In Balochistan, field operations were undertaken in six highland districts including Quetta, Pishin, Mastung, Kalat, Ziarat, and Sibi in collaboration with various institutions. In the Northern Areas, field activities were targeted around Gilgit and Skardu in collaboration with the Aga Khan Rural Support Programme (AKRSP).

Vermiculture and compost fertiliser

A programme of compost fertiliser and vermiculture was implemented in six rural highland districts in Balochistan in collaboration with Khush-Hali Associates (KHA) and the Department of Agriculture, Quetta. A total of 710 compost pits were established on farmers' fields. Farmers were trained in making well-rotted compost for orchard plants. Compost pits measuring approximately 3m x 2m x 1.3m (9' x 6' x 4') were established free of cost on each farm; these produced sufficient compost for 100 apple trees after eight weeks. Thirteen earthworm hatcheries were established in collaboration with the Integrated Pest Management Institute (IPMI), the National Agricultural Research Council (NARC), and the Department of Agriculture Extension, Government of Balochistan, under the sponsorship of NADRI. Four earthworm hatcheries were also established in the Northern Areas in collaboration with AKRSP. These hatcheries are producing foundation stock, which is being introduced in the apple orchards.

Enhancing the Productivity of Orchards

The current yields of apple orchards in Balochistan are quite low compared to other apple producing countries. We anticipated that the productivity of these orchards could potentially be enhanced by up to 30% by improving soil fertility levels, proper pollination management, and pruning of apple trees.

Under NADRI's sponsorship, KHA, Quetta, implemented a programme to introduce modern orchard pruning and honeybee rearing to the rural population in six highland districts of Balochistan as a means of achieving better apple pollination. Awareness among local farmers was created and technology was transferred to them regarding orchard pruning techniques by short-term training of local growers. A survey of the area identified the major constraints and problems regarding apple pollination. Sixty honeybee colonies were provided to orchard producers on an experimental basis. The programme may be expanded in the light of farmers' success in handling and managing these colonies.

Range Livestock Production

Three approaches were chosen to improve animal productivity in the aridlands: nutritional balance through unconventional feed resources, genetic improvement through crossbreeding, and mobile veterinary camps.

Nutritional balance

More than 4000 urea molasses blocks (UMBs) were supplied to the Department of Agriculture, Balochistan and sold at cost to livestock producers in remote areas of the Chagai-Kharan district. The success of UMBs among local farmers has been very encouraging. Arrangements are underway to install one small feed mill at Gilgit and another at Dera Ismail Khan for ruminants in the Northern Areas and Rod-Kohi.

Genetic improvement

NADRI has introduced Angora goats in cold dry temperate regions of Pakistan. Forty male and ten female Angora goats were procured from the Livestock Experiment Station, Rakh Khairewala, and the Government of Punjab. These animals were supplied to the Livestock and Dairy Development Department (LDDD), Government of Balochistan, which has been keeping them for pure Angora breeding in Balochistan.

NADRI procured 60 more Angora bucks and supplied 30 to KHA, Quetta, and 30 to AKRSP, Gilgit. These bucks have been deployed for natural crossbreeding with local goats in mountainous regions of Balochistan and the Northern Areas. Another batch of 50 bucks is being supplied to KHA and LDDD Quetta for Balochistan. Similarly, 10 Friesian bulls were procured by NADRI from LDDD and deployed in various districts of Balochistan for natural crossbreeding through KHA. Another batch of 27 breeding bulls has been purchased for the Northern Areas to be deployed by the Agriculture Department, Gilgit.

Veterinary camps

Three mobile veterinary camel camps were organised by NADRI in Balochistan. Medicines, wheat straw, and UMBs were supplied to farmers in collaboration with the Arid Zone Research Centre (AZRC), Quetta, and LDDD, Balochistan.

Plant Nurseries

NADRI nurseries are a main source of seedlings and saplings, and produce specific plants for specific zones. A four-wing saltbush (*Atriplex canescens*) nursery has been established at Loralai (Balochistan) in collaboration with the Soil Conservation Wing, Forest Department (FD), Balochistan. More than 0.5 million plants are growing and are being planted in different areas of Balochistan. Arrangements have been finalised for raising another 2 million fourwing saltbush plants. A chilghoza pine (*Pinus gerardiana*) nursery has been established at Zhob to encourage large-scale plantation in the Rod-Kohi Sulaiman Mountains.

Dryland Farming

NADRI replicated its successful mechanism for quality seed production in mountain communities of Balochistan and the Northern Areas. More than 100 bags of improved wheat (Chakwal-86 and Sulaiman-96) were distributed among farmers in Balochistan through KHA. Similarly, 150 bags of Chakwal-86 wheat seed were distributed, with payment, among local farmers in Skardu, Northern Areas, by the NADRI field camp at Skardu. Successful wheat seed sowing was carried out by local farming communities in the Chagai-Kharan areas of Balochistan. A fine-row camel drill has also been manufactured by NADRI and is undergoing field trials.

Soil and Water Conservation, Propagation of Medicinal Plants

In collaboration with the Karakoram Agricultural Research Institute for Northern Areas (KARINA), Juglott, NADRI developed cultivation techniques for black zera (cumin) for Northern Areas farmers. About 750 bulbs of black cumin (kala zera) collected in September 1999 were planted in Astore. More than 300 bulbs were planted at KARINA, Juglot in February 2000. Out of 300, 150 plants emerged. At the time of this report, 91 plants have survived and are flourishing.

One thousand plants of pistachio and 1000 plants of three improved varieties of grape were supplied by the Department of Agriculture, Balochistan (Mastung), and KARINA planted 500 of each. Another 100 of each species were planted at Juglot, Astore, Chilas, and Skardu in the Northern Areas; 300 of each were planted by the NWFP Forest Department (Abbottabad); and 100 of each by the KATO Women Centre, which works for community development under the Japan Embassy in Haripur district. The main objective of these plantations is to evaluate the viability of pistachio and grapes in different agroecological regions including the Northern Areas, Kaghan-Naran valleys, and Kohistan district of NWFP.

Farmers' Training

A one-day introductory training programme on raising earthworms and their use in agriculture was held at two locations in Quetta and Mastung during May 1999. KHA,

Quetta, in collaboration with the Honeybee Research Institute, NARC, organised a three-day training course on behalf of NADRI in Quetta during June 1999 on the management and production of honeybee colonies and their use by women for apple pollination. During this course, women were trained as master trainers for the management and production of honeybee colonies in Balochistan.

Training on modern pruning of orchards, particularly apple trees, was given to 120 orchardists in six highland districts of Balochistan by KHA under NADRI sponsorship.

Seabuckthorn Model

The seabuckthorn development activities in Pakistan are following a multi-dimensional model for the country as a whole, as described below.

Establishment of seabuckthorn nurseries

Three seabuckthorn nurseries have been established in Balochistan province, which is severely threatened by the hazards of soil erosion and high run-off due to very low vegetal cover. In view of the fragility of the ecosystem in Balochistan, NADRI decided to launch a large seabuckthorn development programme in this province. A close collaboration was established with the provincial Forest Department (i.e., Directorate of Soil Conservation), Department of Agriculture, AZRC (PARC), and KHA, Quetta.

A small seabuckthorn germplasm evaluation nursery has been established at Patriata near Murree in Punjab province. This site is mainly being used to propagate a Chinese improved variety of seabuckthorn (*Hippophae rhamnoides* sub-sp. *sinensis*). At this location, an arboretum of this Chinese subspecies has been established on more than 4 ha, where about 5000 plants are growing.

Field plantations

Roughly 250,000 seabuckthorn plants were planted all over Balochistan by the Forest Department, the Department of Agriculture, and KHA during March and April 1999. Since it was our first experience in carrying out large-scale plantations, not all collaborators were well prepared, and it took us an unusually long time (15 to 25 days) to plant. Consequently, the plants experienced a great deal of stress, leading to survival rates of 10% and 90%. The success rate was higher at sites where planting was completed earlier and where the plants received irrigation. We were encouraged by the survival results, particularly of seabuckthorn plants at the agricultural farm at Mastung and at a private farmer's land in district Loralai. Unfortunately, severe drought conditions for two consecutive years in Balochistan proved largely fatal to the seabuckthorn plantations.

During February 2000, 185,000 seabuckthorn plants from the Northern Areas were supplied for planting in different areas of Balochistan, North-West Frontier Province (NWFP), Punjab, and Azad Jammu and Kashmir (AJK) in collaboration with AKRSP. The results of field plantation have been very encouraging in northern Balochistan, with 30% to 40% success rates, despite a second successive year of severe drought.

Seed collection and aerial seeding

NADRI and the seabuckthorn development cell, Balochistan, planned for aerial seeding of seabuckthorn in northern Balochistan. AKRSP collected six tonnes of seabuckthorn seed from the Northern Areas. NADRI paid US\$ 2.0 per kg to local farmers and collected 10 tonnes of seeds. AKRSP created awareness among farmers of the high value of seabuckthorn.

Aerial seeding of about 1.5 tonnes seabuckthorn seed was undertaken by NADRI in collaboration with the Soil Conservation Wing (SCW), FD Balochistan, and the Plant Protection Department (PPD), Karachi, along the Alambar Stream and the surrounding areas of Loralai during March 2000. PPD aircraft were used for the aerial seeding operation. More than 4.5 tonnes of seed were manually spread along the Spera Ragha and Surghund areas of Balochistan. The main objective is to achieve conservation of juniper forest during the next decade by providing an alternate fuel and grazing resource within juniper habitat and to improve micro-climatic conditions for young juniper seedlings.

Fruit processing and oil extraction

The Pakistan Council of Scientific and Industrial Research (PCSIR) and NADRI agreed to extract oil from five tonnes of seabuckthorn seed, and to establish a solvent extraction unit of 50 kg/day oil extraction capacity at Skardu. This would initiate oil extraction from seabuckthorn seed and pulp in the Northern Areas for the socioeconomic development of resource-poor mountain communities. NADRI is also working on preparation of a manual and a mechanised seabuckthorn berry harvester.

Five hundred bottles of seabuckthorn carbonated water and samples of 29 other seabuckthorn products have been prepared on an experimental basis by PCSIR and the National Council for Tibb (NCT) in collaboration with NADRI. Table 1 shows details of seabuckthorn products developed on experimental basis.

Research on the medicinal value of seabuckthorn

NADRI plans to create a national database on treatments of various diseases through seabuckthorn oil in acupuncture, unani tibb (indigenous medicine), and allopathy. A

Table 1: Seabuckthorn products

Food Products	Seabuckthorn toffee (seabuckthorn + apricot)
Seabuckthorn drink	Biscuits (sweet)
Carbonated beverage	Biscuits (salty)
Jam (apricot and seabuckthorn)	Seabuckthorn oil
Breakfast cereals (noodles with 5% pulp)	
Breakfast cereals (noodles with 10% pulp)	Cosmetic Products
Seabuckthorn granules	Seabuckthorn cream (vanishing)
Seabuckthorn powder (drink)	Seabuckthorn cream (cold)
Seabuckthorn powder (pulp + chocolate) drink	Seabuckthorn shampoo
Rice pops (with seabuckthorn powder)	
Rice pops (with 50% seabuckthorn oil)	Medicines
Rice pops (with 100% seabuckthorn oil)	Cancer unani medicine
Juice powder (chocolate) drink	Upton skin treatment
Juice powder (normal acidic) drink	Pain relieving capsules
Juice powder (moderate acidic)	Unani cough syrup
Fibrex mix (slightly acidic)	Sharbat seabuckthorn
Fibrex mix (moderate acidic)	

contract has been signed with the Pakistan Institute of Acupuncture and Medical Sciences (PIAMS), Zainab Memorial Hospital, Lahore, for research on seabuckthorn oil and other products as supportive medicine. Preliminary results show that seabuckthorn products may successfully be used as supportive medicines for curing various diseases. Similarly, an agreement has been signed with the National Council for Tibb (NCT), Islamabad, regarding research on the medicinal value of seabuckthorn products in unani tibb. NCT would work to promote seabuckthorn products as supportive medicines in traditional systems. NADRI is supplying seabuckthorn oil free of cost to PIAMS and NCT. NADRI has also arranged with the National Institute of Health (NIH), Islamabad, to initiate research on seabuckthorn's medicinal value in allopathy on the same lines as with PIAMS, Lahore, and NCT, Islamabad.

References

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