

GAP and ICARDA

Ties that Bind



**International Center for Agricultural Research
in the Dry Areas**

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in the Dry Areas

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ICARDA serves the entire developing world for the improvement of lentil, barley and faba bean; all dry-area developing countries for the improvement of on-farm water-use efficiency, rangeland and small-ruminant production; and the Central and West Asia and North Africa (CWANA) region for the improvement of bread and durum wheats, chickpea, pasture and forage legumes, and farming systems. ICARDA's research provides global benefits of poverty alleviation through productivity improvements integrated with sustainable natural-resource management practices. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national, regional and international agricultural research and development systems.



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Collaboration in Agricultural Research
and Development

Ties that Bind

No. 23



Güneydogu Anadolu Projesi



ICARDA

**International Center for Agricultural Research
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Headquarters

International Center for Agricultural Research in the Dry Areas (ICARDA)

P.O. Box 5466, Aleppo, Syria

Tel: (+963) (21) 2213433, 2213477, 2225112, 2225012

Fax: (+963) (21) 2213490, 2225105, 5744622

E-mail: ICARDA@cgiar.org

Website: <http://www.icarda.org>

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Partners in the GAP/ICARDA Project

Guneydogu Anadolu Projesi (Southeastern Anatolia Project, GAP), Turkey

International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria

Southeastern Anatolia Research Institute (SARI), Diyarbakir, Turkey

Koruklu Research Station, Sanliurfa, Turkey

Dicle University, Diyarbakir, Turkey

Harran University, Sanliurfa, Turkey

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INTRODUCTION

GAP (Guneydogu Anadolu Projesi or Southeastern Anatolia Project) is a multisector integrated regional development project in Turkey, and one of the largest integrated rural development projects in the world. It is a multibillion dollar project established in 1977 to promote agriculture and improve the livelihood of farmers in the Southeastern Anatolia Region of Turkey. It covers nine administrative provinces in the Euphrates and Tigris basins and the upper Mesopotamia—Adiyaman, Batman, Diyarbakir, Gaziantep, Kilis, Mardin, Siirt, Sanliurfa, and Sirnak.

The GAP region extends over 75,000 km², approximately 10% of the entire country, and has a population of about seven million. The region has enormous agricultural potential, but is one of the least developed in the country. It has 3.1 million hectares of cropland, 1.1 million hectares of forests, and 2.4 million hectares of pasture and rangeland. The project is ambitious; aiming to make available 1.7 million hectares of land for irrigated farming, enabling farmers to double or triple their harvest.

ICARDA has been implementing collaborative research, training, and development projects with GAP since 1999, highlights of which are presented in this report.



An agreement to expand the work plan for the GAP project was signed in 2004 by Prof. Dr Adel El-Beltagy (left), ICARDA Director General, and H.E. Muammer Yasar Ozgull, GAP President.

PROJECT HIGHLIGHTS

The GAP-ICARDA project is being implemented under two main themes: (i) on-farm demonstrations and seed systems development on wheat, barley, lentil, and chickpea; and (ii) improvement of natural pastures and forage crops, and small ruminant production.

A major challenge to agriculture in the GAP region is the lack of quality seed of improved crop varieties. The on-farm demonstrations and seed development component, therefore, aims to establish a well-defined system for variety evaluation, demonstrations, multiplication, and diffusion, primarily as an extension activity closely linked to farmers. It includes activities to inject material into the formal seed sector and secondary diffusion within the farming communities, with some management to direct seed flows in the most effective way.

▶ On-farm demonstrations

Several trials were conducted at the Southeastern Anatolia Research Institute (SARI), Diyarbakir; Faculties of Agriculture of the Dicle and Harran Universities; and Koruklu Research Station, Sanliurfa; for different crops to select high-yielding cultivars that are tolerant to biotic and abiotic stresses in the region. Subsequently, ICARDA introduced improved and adapted varieties of wheat, barley, lentil, chickpea, and vetch, along with improved production practices such as the use of raised beds in irrigated wheat fields to increase yield and water use



ICARDA lentil breeder discusses the advantages of 'Firat-87' with farmers and GAP staff.

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efficiency. The introductions and adaptations were achieved through on-farm demonstrations with progressive farmers. They were monitored and evaluated by GAP staff, local extension personnel, and ICARDA scientists.

Improved varieties of wheat, barley, lentil, and chickpea were planted in about 404 large-scale demonstrations on farmers' fields in nine provinces of the four governorates, for seven years (1999/2000 to 2005/2006).



GAP-ICARDA project coordinator/ wheat breeder and GAP staff monitor an on-farm trial site on improved durum wheat varieties.



Table 1: Number of demonstrations, cropped area, and quantity of high quality seed used for the different crops

Year	Crop	Number of demonstrations	Area (ha)	Quantity of seed (tons)
1999/2000	Wheat	13	13	2.78
	Lentil	2	1.2	
2000/2001	Wheat	10	3.75	1.53
	Barley	4	2	
	Lentil	4	2	
	Chickpea	2	1	
2001/2002	Wheat	36	48.5	9.9
	Barley	1	1	
2002/2003	Wheat (certified seed)	3	33	16.04
	Wheat (production)	20	34	
	Barley	2	1	
	Chickpea	11	13	
	Lentil (2 varieties)	2	1	
2003/2004	Wheat (certified seed)	9	170	58.71
	Wheat (production)	48	107.45	
	Barley	1	1	
	Chickpea	10	14	
	Lentil	3	5	
2004/2005	Wheat	68	124	33.557
	Barley	15	24	
	Chickpea	10	15	
	Lentil	12	14.3	
2005/2006	Wheat	69	112	41.08
	Barley	25	23.3	
	Chickpea	3	4.4	
	Lentil	21	20.2	
Total		404	788.6	163.597

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In the 2002/03 planting season, the mean grain yields from demonstration plots and regular fields were 5.36 and 3.95 t/ha for irrigated wheat, and 2.70 and 2.60 t/ha for rainfed wheat, respectively. This represents yield increases of 36% and 7% (Figure 1). The yield increases were 27% in rainfed barley, 30% in lentil, and 41% in chickpea (Figure 2).

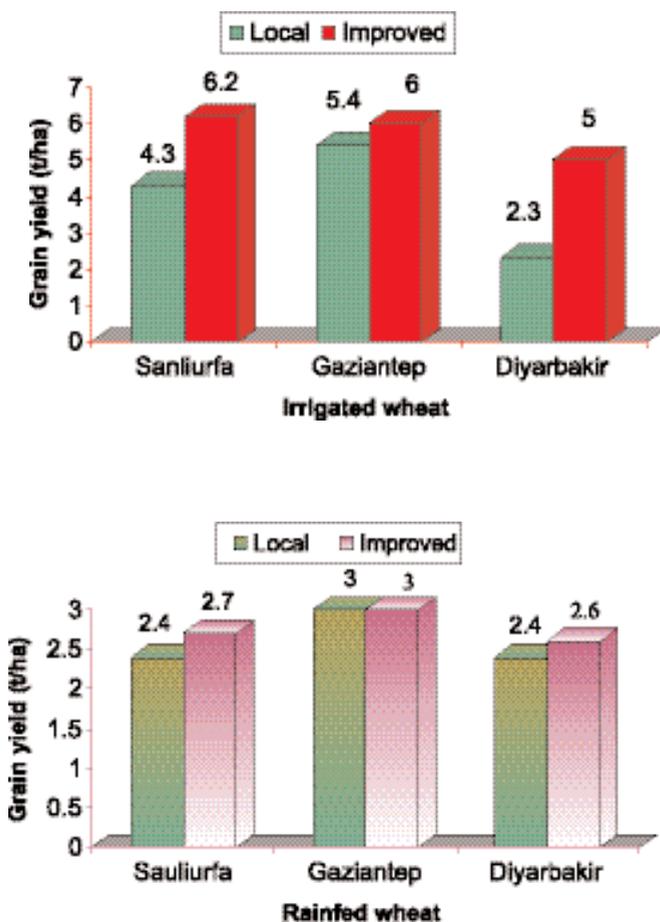


Figure 1: On-farm grain yield of the local and improved wheat cultivars.

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Improved varieties derived from ICARDA germplasm, which are now popular with GAP farmers, include 'Gidara 2' durum wheat, 'Gokce' and 'Diyar 95' chickpea, 'Firat 87' and 'Idlib-3' lentil. ICARDA has also enhanced mechanical harvesting of lentil in the GAP region by introducing upright varieties of the crop.

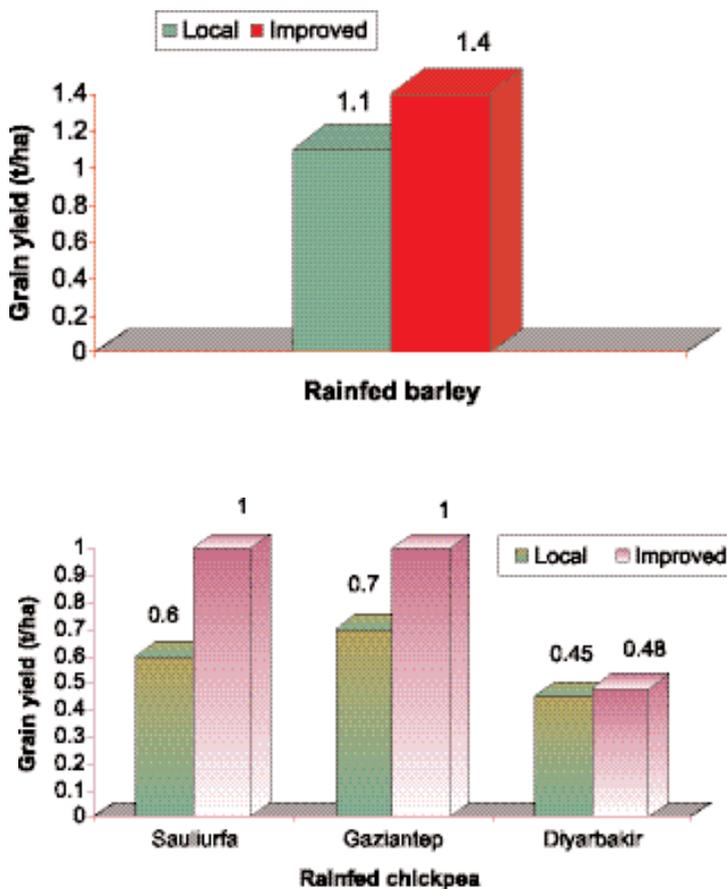


Figure 2: On-farm grain yield of the local and improved barley and chickpea cultivars.

▶ **Seed systems development**

Organized seed production systems for improved crop varieties are lacking in the southeastern Anatolia region. Under the GAP project, ICARDA's Seed Unit provided technical support for seed system development aimed at devising alternative ways of introducing new barley, chickpea, and lentil varieties not currently handled by the formal sector.

A national workshop on 'Defining sustainable seed production and marketing systems for winter cereals and legumes in the GAP region' involving 50 participants was held in Sanliurfa in 2000 to formulate strategies and approaches. This was followed by a training course on 'Seed production and marketing' in 2001 for 21 farmers and staff of the provincial extension department. The course aimed to produce seed locally, and motivate the extension workers to provide the necessary technical support. In addition, 13 participants attended regular courses on seed sector development at ICARDA headquarters. Farmer groups involved in crop and seed production also visited ICARDA and the Syrian national seed program to acquaint themselves with seed production activities and meet other farmers to share experiences.

GAP provided financial support for the establishment of a seed center at Dicle University in order to improve the availability of seed to farmers. The ICARDA Seed Unit provided technical support for the establishment, operation and management of the seed processing facilities, and development of human resources at the Center. Dicle University obtained foundation seed from SARI for multiplication with contract farmers under irrigation. The University has government permission to produce and sell certified seed like any other seed enterprise in Turkey, and produced large quantities of high quality seed.

The second project theme, improvement of natural pastures, rangelands, and small ruminant productivity was to develop an efficient, sustainable, and integrated program to improve native pastures and small ruminant productivity. Focus was on the improvement of marginal land and rangelands to reverse erosion, improvement of natural resource productivity, and conservation of valuable genetic resources for long-term benefit.

► **Improvement of natural pastures**

Natural resources in the GAP region have been rapidly degrading over the past 50 years due to a huge increase in human and animal populations. Vegetation cover is low, and unpalatable species are dominant because of the disappearance of several species palatable to small ruminants. The eroded soil is shallow, infertile, white, and with calcareous marl. The land needs to be rehabilitated through proper management, which should include allowing local communities some access to the improved natural resources without sacrificing ecological values.

Proper management of natural resources requires a proper qualitative and quantitative inventory of the socio-economy, vegetation, and soil, including current land use. In June 2000, GAP and ICARDA agreed to monitor rangeland and biodiversity in a pilot project in Kuyulu. The objectives were to provide information to support future land improvement and rangeland management, establish a reference vegetation map to monitor land use changes, document current land use and carrying capacity, and assist in erosion control.



About 25% of the total land area in southeastern Anatolia is at risk of water and wind erosion.

Twenty hectares of improved rangeland on flat terrain were established. The most commonly used perennial legume was *Onobrychis sativa*, a sanfoin native to Turkey. Several unexpected plant species were identified and collected. Protection of the research area gave many species the chance to regenerate. Six vegetation types with 238 species from 38 families were recorded in the 300 ha fenced area. Forty-eight per cent of these were rated as highly palatable, 35% had low palatability, and 17% were poisonous to livestock.

Geospatial data sets, which included landforms and land use/land cover, were generated from the data collected. The vegetation data set was further classified according to the total biomass, plant species, and vegetation type. The sampling sites for vegetation and soil, and locations of villages where socio-economic data were collected, were also classified.

Table 2. Ground habit and number of species in the six vegetation types

Vegetation type	Number of species
Trees/vines	5
Perennial shrubs	28 (including 4 legume species)
Biennial shrubs	1
Annual herbs	127 (including 30 legumes and 28 grasses)
Perennial herbs	71 (including 10 legumes and 11 grasses)
Biennial herbs	6

► Rangeland rehabilitation

ICARDA provided more than 500 kg of annual forage legume seeds and about 100 kg of fodder shrubs seeds for the rehabilitation of rangelands at Kuyulu. A herbarium with 200 species was established at the GAP Urfa station. More than 1000 seedlings of 20 fodder shrub and 10 grass species were supplied to Harran University to establish a botanical garden.

The cereal-based cropping systems were diversified through the integration of feed legumes. About 1–2 ha of common vetch was planted in farmers' fields in each of the GAP provinces to demonstrate the rotation of vetch with cereals in the harsh environments of southeastern Turkey. The improved vetch varieties provided by ICARDA are helping to reduce erosion, as they cover the soil surface, and livestock spend more time grazing them than the steppe. This will change the marginal and environmentally damaging cropping system into a productive, sustainable, environment-improving crop-livestock system, and increase farmers' income.

Table 3. Legume and grass species provided for rangeland rehabilitation in the GAP region

Non-legume shrubs	Legume shrubs	Grasses
<i>Atriplex canescens</i>	<i>Bituminaria bituminosa</i>	<i>Agropyron cristatum</i>
<i>A. halimus</i>	<i>Colutea istria</i>	<i>A. elongatum</i>
<i>A. halimus-halimus</i>	<i>Coronilla glauca</i>	<i>A. fragile</i>
<i>A. glauca</i>	<i>Medicago arborea</i>	<i>Dactylis glomerata</i>
<i>A. lentiformis</i>	<i>Onobrychis aurantiaca</i>	<i>Eragrostis</i> spp.
<i>A. leucoclada</i>	<i>Onobrychis sativa</i>	<i>Festuca elatior</i>
<i>A. nummularia</i>		<i>Lolium</i> spp.
<i>A. polycarpa</i>	Annual legumes	<i>Oryzopsis miliacea</i>
<i>A. torreyi</i>	<i>Medicago rigidula</i>	<i>Panicum turgidum</i>
<i>A. undulata</i>	<i>M. radiata</i>	<i>Phalaris tuberosa</i>
<i>Kochia prostrata</i>	<i>Trifolium campestre</i>	
<i>Salsola vermiculata</i>	<i>T. pilulare</i>	
<i>Artemisia herba-alba</i>	<i>T. purpureum</i>	
	<i>T. speciosum</i>	

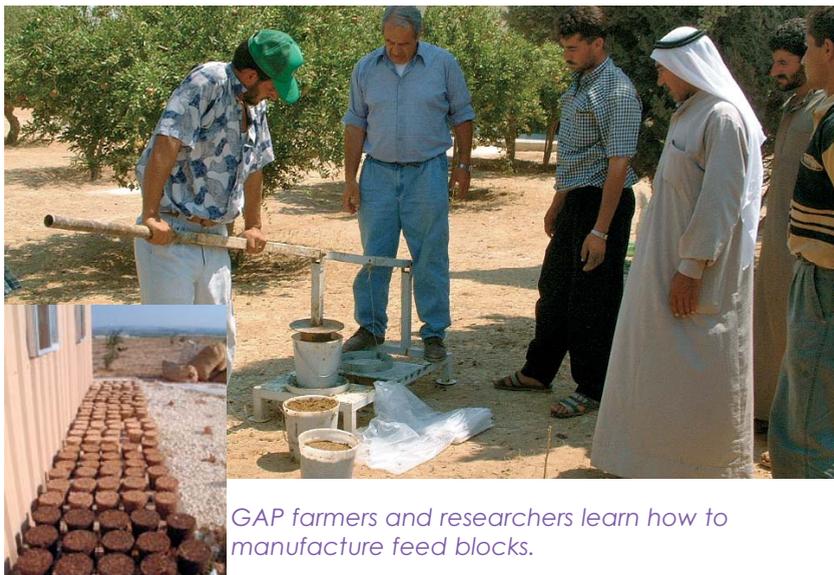
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► Improvement of small ruminant productivity

The major factor affecting small ruminant productivity in the dry areas is the shortage of good quality feed resources that can meet the nutritional requirements of animals. Small ruminants depend mainly on poor quality forages and cereal crop residues for a considerable part of the year. However, large quantities of good quality agricultural and agro-industrial byproducts such as sugar beet pulp, molasses, olive cake, sesame cake, sunflower cake, groundnut cake, tomato pulp, citrus pulp, etc, are available, but are not efficiently used in feeding systems.

ICARDA worked with researchers, extension personnel, and farmers in the GAP region to improve small ruminant productivity through improvements in feed resources to enable them to cope with critical feed shortages. Training courses, field days, and on-farm demonstrations were conducted on new feeding technologies such as the use of feed blocks, urea-treated straw, and strategic feeding to improve small ruminant productivity and milk yield.



GAP farmers and researchers learn how to manufacture feed blocks.

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The feed blocks technology is simple, cheap, and does not require sophisticated equipment. Feed blocks were manufactured with locally available agricultural byproducts, thus promoting their utilization in feeding systems. The technology has proved to be one of the most efficient methods of using urea as a source of nitrogen and a strategic way of supplementing feed to improve small ruminant performance.



Feed blocks now provide supplementary feed sources for sheep in the GAP region.

▶ Introduction of *Mucuna*

GAP researchers expressed interest in trying *Mucuna* (velvet beans) to solve the problem of feed shortages in the region. ICARDA secured short duration species of *Mucuna* from the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria, for introduction into the system. Unfortunately, the species produced high biomass but failed to produce seed. Further trials with different agronomic practices, e.g., changes in sowing date, did not produce useful results. Researchers therefore concluded that *Mucuna* is a short-day plant and is not suitable for seed production in the long-day summer conditions found in the GAP region.



Mucuna produced high biomass but failed to produce seed under south-eastern Anatolia conditions.

HUMAN RESOURCE DEVELOPMENT

Capacity development is an essential component of the GAP/ICARDA collaborative project. The on-farm demonstrations and testing of materials has enhanced the capacity of researchers, extension workers, farmers, and the private sector in the region. Training courses were held in Turkey and at ICARDA headquarters for the project participants. The courses focused on cereal and legume breeding methods; variety management and seed quality assurance; seed production, processing, storage, and marketing; and water management. There were also courses on the use of taxonomic keys of forage legumes, on-farm livestock methodologies, data collection, management, and analysis; strategic livestock feeding; and improvement of milk yields.



A training session on seed processing for GAP staff.

Study tours to ICARDA's experimental sites and farmers' fields in Syria were organized. The tours have increased participants' understanding of the applied research and development activities, germplasm enhancement, and integrated natural resources management, which they are now applying in the GAP region. Four scientists from Dicle and Haran universities were specially trained in breeding methodologies.

Table 4: Training courses provided

Year	Course title	No. of participants
2000	• Seed supply systems	56
	• Rangeland monitoring in the pilot village of Kuyulu	11
2001	• Seed production and marketing	21
	• On-farm livestock research methodologies	11
2002	• Forage, pasture, range and livestock production	10
	• Cereal and legume breeding methodology	4
2003	• Data collection and analysis	15
	• Seed processing and storage	6
2004	• Variety management and seed quality assurance	2
	• Use of taxonomic keys of forage legumes	2
	• Livestock strategic feeding	39
	• Variety management and seed quality assurance	5
	• Data management and analysis	6
	• Strategic feeding of small ruminants and improvement of milk yield	20

SUMMARY OF OUTCOMES

- The improved crop varieties introduced by the project generally performed better than the local cultivars. 'Gidara', an improved durum wheat variety derived from ICARDA germplasm, the Turkish variety 'Pehlivan', and 'Ceylan-95' are performing well. They produced 7–8 t/ha in the 2003/2004 season.
- The barley variety 'Efes' is now popular among farmers because it fetches premium prices due to its good malt quality.
- The chickpea varieties 'Gokce' and 'Diyar-95' and lentil varieties 'Firat-87' and 'Idlib-3' have found their place in farmers' minds and fields. The Seed Exporters Union and Research Company (ITAS), Ankara, supplied 'Gokce', which produces very large seeds. 'Firat-87' is high-yielding and has high-level resistance to wilt. In the 2003/2004 season, it was planted on over 10,000 ha in the Siverek region. A farmer harvested about 3.5 t/ha from his 40 ha land. 'Firat-87' was supplied by ICARDA for the demonstrations but is now available at the Kiziltepe market.

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- The improved vetch varieties provided by ICARDA are very useful in reducing erosion because they cover the soil surface and livestock graze more on them than on the steppe.
- The cereal/vetch rotation technology is promising for resource-poor farmers in this fragile and harsh production environment.
- Small ruminant feeding during critical periods has been improved with the introduction of urea-treated straw technologies and feed blocks.
- Farmers have expressed strong interest in expanding the cultivation of improved crop varieties supplied by ICARDA and in using the recommended production technologies.
- Protection of the rangeland research area gave many useful and palatable plant species the chance to regenerate.
- The data set on landforms and land use/land cover will be useful in formulating a policy of managed grazing to sustain the vegetation in its natural state as it occurred many years ago.



Wheat yields have increased significantly in the GAP region as a result of the on-farm demonstrations.

LOOKING TO THE FUTURE

Farmers in the GAP region have benefited immensely from the GAP-ICARDA collaboration. Some of the farmers involved in the demonstrations now produce and sell quality seed of the improved crop varieties. The project team intends to conduct more on-farm demonstrations to consolidate the gains of the project and introduce more crop varieties and improved technologies.

Village-based seed enterprises will be established in the project area to produce and market seed of improved varieties of major food and feed crops. More courses and study tours will be organized to meet the training needs of farmers. The community-based and participatory research projects being conducted in other areas will be introduced, and an impact assessment of the project will be conducted.

There is a need to further survey the land forms and land use/land cover, collect more specimens, especially in areas with major problems of soil erosion and degradation, and develop a more comprehensive database of the species. The work on ruminant feeding systems will be expanded, while further diversifying the cereal-based cropping systems to improve the rangeland rehabilitation efforts.

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