ICAR RESEARCH COMPLEX FOR GOA

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(Indian Council of Agricultural Research)
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Published by

M.K. Nair
Director
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Materials written and compiled by

K.D. Patil
S. Nagabhushanam
B.C. Virakthamath
A.R. Bhattacharyya
N.S. Nair

Edited by

P.K. Das

Cover Design by

M. Narayanan

Cover Photographs

Top left: Cashew - Bold nuts along with large apple
Top right: Fish cum duck farming
Bottom left: Self employment training - A KVK activity
Bottom right: An exotic rose variety

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A promising short duration rice variety for Goa.

INTRODUCTION

The State of Goa lies between 14 & 16 °N latitude and 73 & 75 °E on the West Coast of India. It has a characteristic warm, humid, tropical climate with cool and pleasant weather in winter months. The South-West monsoon records a total annual rainfall of around 3000 mm. The place experiences a maximum and minimum mean temperatures of 33 °C and 21 °C, respectively and the relative humidity varies between 76 to 86 per cent.

It has an undulating terrain with diverse soil conditions which make it possible to cultivate a wide range of field, plantation and horticultural crops. The North-Eastern zone is mostly hilly with laterite soil while the South-Western and coastal region is sandy, marshy and saline.

State of the Art in Agriculture

Out of the total geographic area of 3,70,672 ha, cultivation is confined to 1,52,895 ha. Among the field crops, paddy, pulses, ragi, sugarcane and oilseeds are important. Major horticultural crops grown in the State are cashew, coconut, mango, vegetables and ornamental crops. The State has a forest cover of 1,05,295 ha and the area under cultivable waste is 83,.687 ha.

a) *Field crops*

Rice is the principal food crop which occupies an area of 53,685 ha accounting for 31% of the total cropped area and 86% of the food-grain production. It is grown both during kharif (43,503 ha) and rabi (10,182 ha) seasons. In general, the yields are high in rabi season (2.7 t/ha) as compared to the average yield of 2.2 t/ha, obtained in kharif season. Rice is cultivated in three principal land types viz., 'ker' lands (coastal sandy and sandy loam soils), 'khazan' lands (coastal saline soils) and 'morod' lands (lateritic uplands). The area covered under high yielding varieties in kharif and rabi seasons is 74% and 96%, respectively. In 'khazan' lands, where salinity is a problem, only one crop of rice is grown during monsoon. Mostly the local varieties like ''Korgut' and 'Azgo' are grown in 'Khazan' lands and the yields are generally poor.

Cultivation of local varieties such as 'Sal', 'Dhavi Patni' 'Morod Kendal' and 'Nermar' is still in vogue in some parts. The high yielding varieties viz., 'Jaya', 'IR-8', 'Jyothi' and 'Annapurna' are popular among farmers. Rice production is often adversely affected by pests and diseases like gall midge, cut worm, BPH and blast disease. Scarcity of labour, inadequate irrigation facilities and salinity problems are some of the major constraints that have affected rice production in the State.

Sugarcane is one of the important cash crops grown in Goa. The area under sugarcane cultivation is 1700 ha with a production of 86,000 tonnes (1987-88). More than 90% of the area is covered with a single variety viz., CO-740. Productivity of sugarcane in the State is low (50.5 t/ha) and so also the sugar recovery (8.5%). Since the cane produced in the state is not enough to meet the requirement of the only sugar factory, concerted efforts are needed not only to bring more area under sugarcane cultivation but also to increase the productivity. Usually, 2-3 ratoons are taken by the farmers and there is a need to evolve suitable package of practices for ratoon management as considerable area (60%) is under raton crop.

Cowpea is the main pulse crop grown on

residual soil after kharif rice. The area under pulses is about 11,000 ha. C-152 and the local variety of cowpea are popular among farmers. Although there are no serious pests on cowpea, the crop is infested by coried bug especially in the first fortnight of its growth.

Groundnut is becoming a popular rabi crop that can be successfully grown by utilizing the residual soil moisture of rice fallows. The area under groundnut cultivation is 1374 ha and the popular varieties are Spanish improved and JL-24. Ragi is another crop that is grown in 1176 ha while the area covered by maize is almost negligible (about 180 ha).

b) *Horticulture*

Goa enjoys a humid tropical climate suitable for growing several horticultural crops like cashew, mango, coconut, banana, pineapple etc., besides varied types of vegetables and ornamentals. It is estimated that nearly 62% of the cultivable area is occupied by horticultural crops including smallholder plantation crops in the State.

Cashew is the major horticultural crop of Goa, occupying nearly 4,5000 ha (28%) of the total cropped area of about 1.5 lakh ha. The production and productivity of cashew is poor and there is scope to augment cashewnut production in the State. Goa is a major leading State cultivating cashew crop not only for its kernel but also for producing well-known alcoholic drink ''feni'' and it plays very important role in the State's economy. Total production of nuts and cashew apple in 1986 has been estimated to be 13,500 tonnes and 81,000 tonnes, respectively. About 10 lakh litres of cashew feni is produced annually fetching a sizeable revenue of Rs. 82 lakhs to the Exchequer. Next in importance to cashew is coconut which occupies nearly 22,000 ha of area mostly in the coastal plains. Most of the existing palms are old and need to be replaced with good planting materials. There is scope to step up production of nuts in several existing plantations by adopting package of practices.

Mango is yet another important horticultural crop of Goa, mostly grown in house compounds. These trees have been planted long ago and most of them are old and unproductive. The area under mango cultivation is estimated to be around 3000 ha and reliable production details are not available. It may be noted here that some valuable trees are unwittingly being removed through the various developmental activities. There is however, urgent need to conserve some of the best varieties of mango introduced by the Portuguese.

Pineapple is planted on hill slopes and maintained as rainfed crop while banana is grown using the suckers of local varieties, viz., 'Rasbalim', 'Saldattim', 'Savarbonim,' 'Myndolim' etc. in fragmented holdings. No systematic cultural practices are adopted to reap good harvests from these crops. Papaya, chikoo, guava and other miscellaneous fruit crops are grown in small holdings and in the backyards. Tree spices, viz., cinnamon, clove, nutmeg and black pepper are grown in sporadic manner.

Different types of vegetables, such as, bhendi, brinjal, sweet potato, radish, cowpea, chillies, gourds and greens are cultivated in tiny holdings. The production of vegetables being scanty to meet the local demand, truckloads of vegetables arrive almost daily from the neighbouring states of Karnataka and Maharashtra to make good the demand.

The people of Goa are fond of ornamental plants both for indoor and outdoor decorations and due to lack of well developed nurseries, the plants are often brought from outside the State.

State of the Art in Animal Husbandry

Goa is unique in its food habits, as majority of the population is non-vegetarian. As a

result, there is a lot of scope for livestock production. According to the 1982 livestock census, the total livestock and poultry in Goa is 8,40,734. The major species are cattle (1,20,304); buffalo (42,317); pig (71,604); goat (22,704); sheep (687); and poultry (5,83,008). Although the buffalo number in Goa is much less than the cattle, it is generally considered as the better milch animal because of the higher average yield and high fat content of buffalo milk, as compared to the local cattle. The buffalo milk accounts for about half of the total milk production of the State.

a) *Cattle and buffalo*

Majority of cattle population of Goa consist of poor quality non-descript type with infertility problems leading to low reproductive efficiency, and as a result the cross breeding programme initiated is greatly hampered. Similar is the case with the buffaloes. Moreover, there is no artificial insemination programme for breed improvement in buffaloes.

b) *Pig*

Pig rearing is confined to the Christian community who maintain the local long-snouted, black, non-descript breed of inferior quality, on scavenging system. The better, exotic types of Yorkshire are found in small units such as in Animal Husbandry Farm of Christian Institutions and with a few progressive farmers. More than 40% of the Goan population being pork-eaters, the scope of pig rearing on scientific lines is promising through upgradation of the local pigs.

c) *Goat*

The total goat population is primarily maintained by the poor tribal people in the hilly areas. Although the goat is an important meat animal this species has not received appropriate attention for exploitation of milk and meat production in the State. In general, the goats in this region are smaller sized non-descript type. In view of the important role played by this species in the economy of the poor farmers, there is good scope for introduction of developed breeds to produce dual purpose crosses for maintenance under stall fed conditions.

d) *Poultry*

Although the poultry population has gone high in the recent years, there is a great demand for poultry products particularly because of the expansion of tourism. The major constraints of poultry production in the state is the non-availability of quality chicks and economic feed, locally. Further, there is excellent scope for diversification of poultry through introduction of other species like ducks and quails, to ensure supply of quality poultry meat.

e) *Feeds and Fodder*

In Goa, there is a general shortage of fodder particularly during the dry months. The chief fodder for cattle consists of "Karad" (*Andropogon contortus*) and paddy straw. These are poor quality fodders, the nutritive value of which could be moderately improved by enrichment processes. With regard to the nutritive value of the grasses growing wild in the forest areas, no information is available and this field offers ample scope for systematic research. There is dearth of concentrate feed and most of it is brought from the other states. However, in Goa, a number of agro-industrial by-products are available which can be economically incorporated in livestock feed.

State of the Art of Fisheries

The aquatic resources of Goa consist of a coast-line of 105 km, 555 km of riverine network, 13,160 ha of estuary, 18,500 ha of 'Khazan' inundations, 3,500 ha of brackish waters, 3,250 ha of reservoirs, 100

ha of ponds and bhandaras and about 200 ha of rejected old mine pits.

The present marine fish landing of Goa is 33,070 tonnes (1987) which includes 2,700 tonnes of prawn. The inland fisheries production is about 1,500 tonnes (1987) with an addition of 1,000 tonnes of molluscs.

The brackish waters offer a good scope for prawn production which has a demanding export market. River margins, ponds, lakes, mine pits and reservoirs offer a good scope for composite fish culture, pen and cage culture and integration of livestocks like pig, duck and poultry, thereby to recycle their organic wastes into protein food. The 9,600 ha of rice-fields where 2 crops are taken and some of the ''khazan'' land offer a good scope for synchronous culture of fish and rice to increase production.

ACCOMPLISHMENTS OF THE COMPLEX

Indian Council of Agricultural Research (ICAR) established the ICAR Research Complex for Goa in April 1976. The administrative and technical control of this Complex was however vested with Central Plantation Crops Research Institute, Kasaragod. During the initial period, the Research Complex functioned in different Government farms and farmers' fields and was finally shifted to the present location at Ela, Old Goa in 1982. The State Department of Agriculture, Goa had handed over an area of 19.4 ha to this Complex in 1984.

To intensify the transfer of farm technology and to impart grass root level vocational training to the farmers and the unemployed youth, a Krishi Vigyan Kendra was established in the same campus in 1983.

For expansion of the research, demonstration and training activities of the ICAR Research Complex an area of 34.4 ha was handed over by the Goa Government during the year 1987.

Objectives

i) To undertake research on staple foods and other economic crops of Goa and adjoining coastal areas.
ii) To undertake research in the field of animal sciences.
iii) To undertake research to enhance inland and marine fisheries production.
iv) To provide an adequate production oriented research base.
v) To raise the level of technical competence by training local manpower and to impart technical advice.
vi) To improve local output and bring about economic upliftment.

Achievments

Crop Sciences

a) Field crops

Local germplasm of rice was collected and evaluated. The varieties 'Damgo' and 'Babri' being tall and late maturing were found suitable for low lying areas. For 'Ker' lands, the medium duration varieties such as 'Nermar', 'Khochri Patni' and 'Belo' proved to be promising. 'Dhavi Patni' and 'Morod Kendal' were the early varieties (95 days) suitable for 'morod' lands.

Varietal trials were conducted to identify high yielding short and medium duration varieties. A short duration culture 'IET-6223' performed consistently well and it was released as 'Goa-1' for cultivation in this State. This variety having short bold grains, matures in about 110 days and it is suitable for both 'kharif' and 'rabi' seasons. Among the medium duration varieties, 'IET-6213 and 'Sarjoo' were promising but their yield was not significantly higher than *'Jaya'*. A fine grained variety 'Bhavani' also performed well. The early maturing, dwarf varieties 'AU-1' and 'CSR-4' proved to be suitable for 'khazan' lands where there is no flooding and submergence. For areas subjected to flooding, 'Rajarajan' (140 days) was found suitable.

The NPK dose of 80:60:60 kg/ha when applied in three split doses i.e., 50% at transplanting, 25% each at tillering and boot leaf stage enhanced yield in short and medium duration varieties. Application of lime @ 1 t/ha has helped in correcting the acidity of coastal soils of Goa. In another nutritional requirement trial with three levels each of N, P and K, significant response was found only for nitrogen and maximum yield of 6.3 t/ha was obtained with 150 kg N/ha. The herbicides butachlor (Machete) @ 20

kg/ha and benthiocarb (Saturn) @ 25 kg/ha when applied about 6-8 days after transplanting effectively controlled the weeds.

The cultures 'CR-94-721-3' and 'IET-7918' were found to be tolerant to gall midge. For controlling major pests of paddy, application of carbofuran 3% granules @ 20 kg/ha on 10th day after sowing in the nursery followed by root dipping of seedlings in chloropyriphos (0.02%) solution for 12 hours before transplanting and subsequent application of carbofuran 3% granules @ 20 kg/ha on 20th day after planting along with impounding water for three days was suggested. In view of severity of BPH in recent years, field surveys were carried out periodically and suitable pest management practices were suggested to farmers.

A preliminary evaluation of 92 sugarcane varieties was carried out and 12 promising varieties were multiplied for further trials. A varietal-cum-manurial trial was conducted with 6 varieties identified for Peninsular zone. The variety 'CO-7527' performed better with a cane yield of 161.4 t/ha in plant crop and 118.4 t/ha in ratoon crop. A dose of 250 kg N/ha was found to be the most economical dose resulting in higher yield both in plant and ratoon crop.

Increased income from unit area: Sugarcane based farming system.

Pulses grown in rice fallows have great potential as they not only bring additional income to the farmer but also improve soil fertility by fixing atmospheric nitrogen. Among the cowpea varieties, 'C-152' was found to be the best (10 g/ha). In recent trials, the variety 'DPLC-210' outyielded 'C-152' with an average yield of 12.5 g/ha. 'S-288' and '61-B' were the best vegetable types. Evaluation of pigeon pea varieties indicated the superiority of 'Pakanjore' in respect of yield and tolerance to sterility mosaic disease. Several demonstrations were conducted with 'Phule pragati' variety of groundnut and the yield was about 2.0 t/ha.

b) Horticultural crops

The salient features of the research work carried out since 1982 when the ICAR Research Complex started functioning at Old Goa are detailed below:

(1) *Fruits*

(a) *Mango:* With a view to evaluating the performance of promising varieties of mango under the agro-climatic conditions of Goa, the following varieties have been collected and planted in a block during the last five years and the performance of these varieties is being studied.

(1) Ratnagiri Alphonso, (2) Neelum, (3) Totapuri, (4) Rumani, (5) Kalapady, (6) Mallika, (7) Pairi, (8) Mulgoa, (9) Neel Goa and five hybrids (H-45, H-87 and H-151 and Neelum × Swarnarekha) obtained from Taliparamba of kerala State.

Besides the above, 11 popular varieties of Goa have also been added to the existing collection as detailed below: (1) Mankurad, (2) Hilario, (3) Fernandin, (4) Musarat (Salcete), (5) Colaco, (6) Furtad, (7) Mangarosa, (8) Kesar, (9) Maxima (10) Ball, (11) Ovalappus. To enrich the existing collection, grafts were prepared from the following selected individual mango trees for further planting (1) Saccaradin, (2)

'Amrapali': A promising variety of mango.

Udgoa, (3) Malgesh, (4) Salgadin. Further selection and collection of promising mango varieties is being continued.

Out of the earlier planted varieties, Ratna, Amarpali, Neel Goa and four hybrid types (H-151, H-87, H-45 and H-56) bore few fruits in the last year. Of these varieties, the quality of Amarpali and H-87 were found to be superior over others with T.S.S. 19° Brix and 24° Brix respectively.

b) *Cashew:* Thirteen promising varieties of cashew have been procured and established in a block, besides establishing a scion bank with 'Vengurla-4' which enjoys wide popularity amongst the growers of the State. Keeping in view of the importance of both the seednut and the cashew apple, a survey was undertaken during 1986-88 to identify the chance seedlings from 12 different locations in the State. Important economic characteristics like yield (raw nut), nut weight and quality of apple were taken into consideration while selecting a tree. Grafts from eight locally selected cashew trees were prepared to carryout the progeny test. The grafts were planted in four locations in the State in 1988 to evaluate their performance.

Crop improvement through better methods of vegetative propagation: cashew.

Seven demonstration plots were established with 'Vengurla-4' and 'Vengurla-1' cashew varieties obtaining the grafts from NRC (Cashew), Puttur in collaboration with M/S. Zuari Agro Chemicals, Goa. A 'top-worked' cashew demonstration plot was established in the ICAR Complex to demonstrate the feasibility

c) Coconut – 5000 seedlings of Banaulim variety
d) Arecanut – 5000 seedlings of Mangala variety
e) Papaya – 1000 seedlings of 'Coorg Honey Dew' and 'Solo'

Besides the above, few guava layers, pineapple suckers, banana suckers, tapioca tubers, pepper and sweet potato cuttings etc. were also made available to the growers.

Animal Sciences

1. Cattle

Establsihment of reproductive norms under Goa condition

In pure Red Sindhi, the average age at maturity was 2073 days, and intercalving period was 658 days, whereas Red Sindhi × Jersey cross matured by 512 days with an intercalving period of only 441 days.

The cross breds in village conditions reach puberty when they attain a girth size of about 135 cm. This will be a useful guide under field condition to ascertain maturity of heifers.

The occurrence of normal oestrus cycles was only to the extent of 44-51% cases whereas short cycles and multiple cycles were 8% and 15% respectively.

In the cros-breds only 40% exhibited oestrus within 60 to 90 days and 16% of animals had first post-partum oestrus without ovulation. Complete involution of uterus occurred in cross-bred cows between 28-60 days (av. 43 days). These findings would be very useful in successful implementation of artificial insemination.

Seasonal variations in reproduction

Monsoon season was found to be favourable period in cross-bred cow for fertile heat, whereas winter season was found to be favourable for quality semen production by Jersey bulls in Goa.

Infertility investigation

Incidence of infertility problems was identified to be as high as 51% in bovines in Goa. The major problems observed were long post-partum anoestrus condition, repeat breeding, infantile genitalia and silent oestrus of hereditary nature.

Imbalance of calcium and phosphorus was found to be a major cause for anoestrus condition in cattle.

Brucellosis was identified to be the major etiological factor of infectious infertility in the purchased crossbreds.

Clinical trials to restore fertility

a) I/M injection of 5 ml Tonophosphon and 2 ml Vitamin A for 5 consecutive days was found effective in restoring fertility (67%) in true anoestrus cows.

b) Administration of clomiphene citrate orally @ 1 mg/kg body weight was found effective to induce oestrum in 80% and 50% with a conception rate of 37% in sub-fertile cows and buffaloes respectively.

c) Intramuscular injection of a single dose of Luteinizing Hormone (L.H.) @ 1000 I.U. was found effective for restoring fertility upto 80% in cows having endocrine imbalance (Luteal cyst).

d) L.H. @ 4500 I.U. as a single dose was found to cure nymphomaniac condition in crossbred cows due to folicular cystic ovarian condition. Avil @ 8 ml was injected prior to injection of L.H. to avoid shock.

e) Infusion of 2 ml of Lugol's iodine solution in normal saline was effective to cure 60% of endometritis cases and improve reproductive efficiency in cows.

Investigation on parturtion and post partum conditions

It was observed that dystokia, utero-vaginal prolapse and retention of placenta were the major conditions met under Goa field conditions. Unhygienic-condition of byre and extreme malnutrition were identified as predisposing factors for the same.

Reproductive managements

a) Enucleation of corpus luteum (CL):

This technique could be successfully carried out in the management of silent ovulators in dairy cattle with a very high percentages of success (30.90%).

b) Post partum reproductive management:

5 ml Tonophosphon along with 2 ml Vitamin A on the 64th day after calving could successfully settle 75% crossbred cows at the desired time within 21 days from the treatment.

c) Presistant C.L. conditions in cattle was effectively managed by injection of 25 mg Prostaglandin F2 alpha (Lutalyse 5 ml) with 100% success.

d) Clomiphene citrate @ 1 mg/kg body weight was found to induce good fertility in crossbred cows, however, this drug was not suitable for oestrus synchronisation as wide variation (2 to 15 days) was observed in manifestation of oestrus after administration of the drug.

Sterilisation of male

Caudectomy operation was performed successfully, in calves to sterilise (without castration) which would help maintenance of male vigor for draught purposes as well as successful implementation of artificial insemination.

Introduction and screening of improved fodder varieties

The studies so far have indicated that NB-18 were the most promising perennial grass varieties for irrigated and rainfed conditions. Among the cereal fodders 'South African Tall' (maize) recorded maximum green fodder yield of 34 t/ha. The leguminous fodder varieties like cowpea, subabul and lucerne also performed very well.

Fodder perservation

Silage treated with 2% molases had maximum digestibility.

Enrichment of karad hay and paddy straw

Alkali treatment of karad hay with 8% sodium hydroxide and acid treatment of paddy straw with 0.1 N sulphuric acid improved the digestibility by 20%.

Economic utilisation of by-products as cattle feed

By survey it was found that about 8000 t of rice bran, 1200 t of brewary grain waste, 4000 t of molasses and 100 t of dry cashew apple waste were available annually in the State which can be utilized as animal feed.

Dairy cattle feed was formulated by completely replacing costly wheat bran with locally available rice bran (40%) and partially replacing maize with molasses (10%) which could reduce the feeding cost of milk production by Rs. 0.35 per litre.

Similarly a dairy cattle feed was formulated during cashew season (summer) partially replacing costly groundnut cake with cashew apple waste (10%).

Nutritional status

The studies on nutritional status showed the existence of marginal deficiency of calcium and imbalance in the calcium: phosphorus ratio in the blood.

2. Pig

Two exotic breeds viz., 'Yorkshire' and 'Landrace' were introduced and maintained alongwith local breed under stall fed conditions and were being evaluated.

Performance studies

In pure 'Yorkshire', gestation period ranged from 112-120 days and average litter size was 8. The body weights at birth was 1.2 kg, at weaning 10.25 kg and at 7 months 45 kg. The average daily weight gain was 200 g.

In local pigs, under stall fed conditions, gestation period was 114 days with a litter size of 4. The body weight at birth was 0.4 kg and at weaning was 7.5 kg.

Crossbreds were successfully produced, overcoming the disparity in body sizes by mating young exotic boars with local sows.

Upgraded local pig: Local × Yorkshire cross.

The gestation periods were 116 days with a litter size of 5 and 118 days with a litter size of 7 for 'Yorkshire' crosses and 'Landrace' crosses respectively. The body weight at birth was 0.72 kg and at weaning was 8.2 kg for 'Yorkshire' crosses, while for 'Landrace' crosses it was 0.83 kg at birth and 8.35 kg at weaning.

The carcase characteristics of 'Yorkshire' cross under field conditions and local pig under stall fed conditions were studied.

Nutrition

Incorporation of tapioca chips (40%) in commercial pig ration reduced the cost of feeding by 30 paise/kg feed.

3. Rabbit

Four meat type rabbits viz., 'Soviet Chinchilla', 'New Zealand White', 'Grey Giant' and 'White Giant' were introduced and were being valuated along with the non-descript indigenous breeds. The gestation period ranged from 31-32 days for exotic and 30-31 days for local. The litter size was 6.3 for exotic and 4.6 for local. The kindling percentages for 'Soviet Chinchilla', 'New Zealand White', 'White Giant', 'Grey Giant' and local were 78.5, 41.1, 50.2 and 68.7 respectively.

Among the exotic breeds 'Soviet Chinchilla' performed best under local conditions. Crossbreds were produced between 'Soviet Chinchilla' and local and their performances were being studied.

Upgrading the rabbit: Local × Soviet Chinchilla cross rabbit.

The body weights at marketable age (4 months) for 'Soviet Chinchilla', local and their crosses were 2.1 kg, 1.5 kg and 1.7 kg respectively. The feed efficiency was 2.9 for 'Soviet Chinchilla', 4.2 for local and 3.2 for their crosses.

4. Poultry

A survey revealed that non-availability of goodquality breeding chicks and economical feed, locally, as well as lack of an organized system for efficient marketing of poultry products were the major constraints for poultry development in the State.

'HH 260' (White Leghorn strain cross) released from Central Poultry Breeding Farm, Hesarghatta, was introduced and evaluated. This strain was found suitable for intensive egg production because of their early maturity (155 days), better egg production (65.3%) and better feed efficiency even during monsoon (1.8 kg feed/dozen egg). A franchise hatchery was arranged with the

Evaluation trials for better poultry development.

Department of Animal Husbandry for the production and supply of chicks to farmers.

A breed cross between 'White Leghorn' and 'Austrolarp' was produced which was found suitable for backyard system of poultry rearing, because of their adaptability for free range system, better egg production (Avg. 195/hen/year) and better growth rate (1127.6 g at 14th week) as compared to desi fowls.

For broiler production the released broiler breed 'IBB 83' was introduced from AICRP Centre, Bangalore and evaluated.

The parental stock had a negligible (1.6%) rearing mortality. They started laying in 6 months and peak production (62.4%) was during the eighth month. The fertility was 85% and hatchability was 63.1%.

The hatched out hybrid broiler chicks were reared under deep litter system upto 10th week. The body weight was 760.7 g, 1249.0 g and 1403.0 g at sixth, eighth and tenth week respectively. The feed efficiency was 2.15, 2.27 and 3.71 for 6th, 8th and 10th respectively, indicating that it would be profitable to market the birds at the 8th week.

For diversification of poultry production, ducks and Japanese Quails were introduced and their performance was studied under local condition.

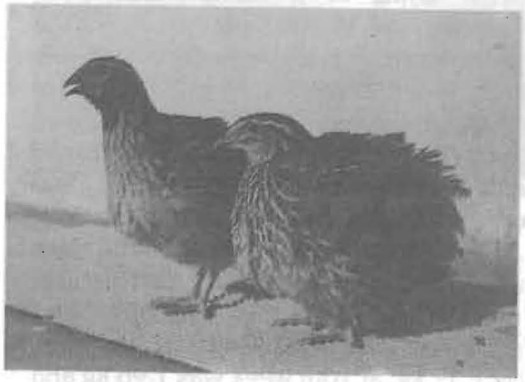
Khaki Campbell layer type duck was introduced from Central Duck Breeding Farm, Hessaraghatta, Bangalore and maintained under deep litter system. The rearing mortality upto adult stage was 9.6%. Initially the growth rate was very fast attaining a body weight of 1354 g at 10th week. The adult weight was 1541 g. Average adult feed intake was 120 g per day. They started laying in 6 months and peak production (64.1%) was attained during the eighth month. This laying performance was much lower than their performance at Bangalore. However, because of their faster growth upto 10th week (1.35 kg), 'Khaki Cambell' ducks could be used as a dual purpose breed under Goa conditions.

A meat type duck, 'White Pekin', was introduced from Kerala Agricultural University, Mannuthy, Trichur and maintained. The body weight at 8th week was 1.52 kg, at 10th week was 1.96 kg and adult weight was 2.87 kg. They started laying in the 7th month and attained peak production (65.2%) during 8th month. The average egg weight was 61.5 g.

The Japanese Quails were introduced from Central Avaian Research Institute, Izatnagar and maintained both in cages as well as in deep litter. The quail chicks weighed 7 g at hatch, 73.85 g at 5th week and 115.23 g at

'White pekin' - A fast growing table bird.

6th week. The adult weight (8th week) was 139.8 g. They started laying during the 7th week and the peak production (82.15%) was attained during the 20th week. A higher rate of laying was maintained from 2nd to eighth month after which there was a decline in the rate of laying. Average egg weight was 10 g. Fertility and hatchability was 80% and 72% respectively.



Japanese quails.

Low cost starter, grower and layer rations were formulated incorporating the locally available cheap ingredients like rice bran, brewary grain waste, molasses, fishmeal etc., as partial replacement of costly ingredients like maize and groundnut cake. The feeding trial with these rations indicated that the feeding cost can be reduced by 15 to 20% without any adverse effect on the health of the bird and production.

Comparative clinical trials were conducted with conventional drugs like antibiotics, sulpha drugs and nitrofurans, and Homoeopathic drugs selected on the basis of the totality of symptoms. It was observed that Pulsatilla, Ipecac and Arsenicum Album were more effective, economical and safe for the treatment of Coryza, Infectious Bronchits and Coccidiosos respectively as compared to conventional allopathic drugs. These newly identified Homeopathic drugs were extensively used for the treatment and control of field out-breaks of the above mentioned common poultry diseases in the State.

Fisheries Sciences

Fish-livestock farming systems

Innumerable small and large fresh-water spreads are available in Goa which are not fully exploited for fish culture. For economic exploitation of these water bodies trials on fish-livestock farming systems involving duck, poultry and pig in combination with fish were initiated. Three freshwater ponds were excavated and stocked with fingerlings of four species of carps (catla, rohu, mrigal and common carp). White peckin ducks are being maintained in a floating cage in one pond. Pig and poultry units are being established in the other two ponds, respectively.

Rice-cum-fish culture

Rice cultivation in Goa is becoming increasingly less remunerative due to high cost of labour and other problems. In order to obtain economic returns from rice fields a rice-cum-fish combination was introduced for low-lying fields. One-tenth of the field was deepened into a pond. Advanced fingerlings (raised separately) of four species of carps namely, catla, rohu, mrigal and common carp were stocked and reared synchronously with 2 crops of rice. The popular variety 'Jyothi' (yield - 4.3 t/ha) was found suitable for the combination. Individual fish growth of 800 g/8 months was obtained. The work is continued to further identify better varieties suitable for local conditions.

KRISHI VIGYAN KENDRA

Krishi Vigyan Kendra is implementing two important schemes under the programme 'Transfer of Technology' for increasing

employment opportunities, agricultural production and income of farming community. They are (1) farmers and unemployed youth for self-employment, and (2) transfer of technology for agricultural production (Lab to Land Programme).

KVK Training

Krishi Vigyan Kendra is imparting production oriented training through the process 'teaching by doing' and 'learning by doing' in the fields of agriculture, horticulture, animal science, fisheries and home science to practicing farmers, school drop-outs and other rural youths for self-employment, health and hygeine. The training programmes consist of improved production technology for crops such as rice, pulses, oilseeds, vegetables, fruit crops, intensive cultivation practices such as mixed cropping, high density cropping, and mixed farming. Under animal sciences, training is imparted in dairy, piggery, poultry and rabbit farming. In fisheries, the prawn and fish culture training was imparted, the home science training included tailoring, embroidery, handicrafts, food and fruit preservation, cooking low cost recipes, fabrication of low cost indigenous home appliances, health and child care. The duration of training varied from 2-3 days to 3 months depending upon the requirement of various training courses. The trainings were conducted either at KVK, Old Goa (on campus) or at villages (off campus) and Rs. 8/- per day was paid to the trainees as stipend. During the period from 1984 to 1989, 189 training courses were held and 3180 people were trained. Among the training courses, three months nursery man's course was very popular and few trained persons have already started their own nurseries.

Lab to Land Programme

Under this programme, during phases III, IV and V (1984, 1985, 1986, 1987, 1988 and 1989) 250, 104 and 100 farm families respectively were adopted. A bench mark survey of the selected farm families was carried out to collect data regarding the socio-economic status, the availability of resources like land, finance and man power and also their performance for farming practices.

Based on the data of survey, the farm families were grouped into few categories and a team of Scientists representing various disciplines in consultation with farmers, formulated the farm plans (improved technologies for implementation). The technologies included crop production, horticulture and livestock production. The farmers were given training according to the farm plan and were provided with critical inputs worth Rs. 500/-. These critical inputs included improved seeds and planting material, fertilizers, plant protection chemicals, etc. for the cultivation of specified crops. Under animal sciences, breeding stocks of pigs, rabbits and poultry, fodder slips and mineral mixtures were supplied as critical inputs for establishing small units. The progress was monitored by periodic visits by the scientific and technical staff. Among the various technologies transferred, cultivation of improved rice variety (Goa-1) growing groundnut (JL 24), vegetables and sweet potato '76 (OP) 219' and 'Cross-4' became quite popular. In livestock production, backyard poultry and rabbit rearing became extremely popular because of quick returns. In the field of horticulture, improved planting material of coconut, cashew, papaya and spices were supplied.

RESEARCH THRUSTS DURING VIII PLAN PERIOD

I. Crop Sciences

a) *Field crops*

1. Identification of high yielding rice varieties of different maturity groups suitable to specific growing conditions like *morod, ker* and *khazan* lands with special emphasis on the former.
2. Evaluation of fine grained varieties in view of great demand following modernisation of rice processing mills.
3. Evolving suitable labour saving and low cost rice production technologies for the agro-climatic conditions of Goa.
4. Studies on introduction and popularisation of new green manure crops and biofertilizers in rice production and preparing manurial guide including the micronutrients.
5. Evolving suitable rice based cropping systems for efficient utilization of available land resources.
6. Screening released rice varieties against major pests and diseases and formulating suitable control measures and integrated pest management practices to combat pest problems.
7. Studies on management of saline soils for rice production by using suitable soil amendments.
8. Studies on utilization of mine reject soils of Goa.
9. Evaluation of high yielding sugarcane varieties of different maturity groups suitable for the agroclimatic conditions of Goa.
10. Evolving suitable package of practices for economic cane production and as well for ratoon management as about 60% of the area is under ratoons. Preparing nutrient guide for sugarcane cultivation.
11. Introduction and evaluation of improved varieties of crops like moong, cowpea, moth bean, soybean and other pulses and oilseeds like groundnut and sunflower.
12. Standardizing suitable package of practices for cultivation of different pulses and oilseeds.

b) *Horticultural crops*

1. Development of new area of 34.4 ha
2. To develop infrastructure for large scale multiplication of planting materials of economic importance like cashew, mango etc.
3. To evaluate varieties of different fruit crops suitable for Goa and to suggest package of practices for their culture.
4. Testing of promising vegetable types for their yield and resistance for pests and diseases of common occurrence.
5. Evaluation of tree spices for their performance and to multiply the promising ones for supply to different developmental agencies.
6. Collection and conservation of the species of economic importance such as Kokum, mangostene etc.
7. Collection and multiplication of important ornamental plants.
8. Studies on mushroom culture.

II. Livestock Production

Cattle and Buffalo

1. Identification of suitable crossbred cattle and buffalo for more milk and meat production.
2. Establishment of Centre for studies on

Animal Reproduction including quality semen production and imparting technical training.
3. Improving reproductive efficiency of cattle and buffalo by conducting researches on infertility problems and better reproductive management.
4. Identification and testing of suitable fodder and forage varieties and standardisation of their feeding and preservation techniques.
5. Evolving suitable methods for enriching locally available forages/fodder.
6. Utilization of locally available by-products/waste products for economic feeding.
7. To conduct nutritional studies on dairy cattle and working out suitable feeding methods for economic production.
8. Studies on disease aspects to evolve suitable preventive and control measures.

Pigs

1. Evolving suitable crossbreds involving Yorkshire, Landrace, Saddleback and local breeds of pigs.
2. Improving their reproductive efficiency.
3. Economic feeding using by-products/ waste products, tuber crops etc.
4. To study pig diseases for preventive and control measures.

Goat

1. Introduction and evaluation of indigenous and exotic milch and dual purpose breeds of goat.
2. Production and evaluation of crossbreds under stall-feed condition.
3. Studies on reproductive aspects.
4. Studies on nutritional aspects.
5. Studies on health aspects.
6. To evolve suitable package of practices for management under stall-fed condition.

Rabbits

1. Introduction and testing of rabbits for meat production.
2. To conduct studies on various aspects of reproduction.
3. To conduct nutritional studies.
4. Studies on management to evolve suitable package of practice.
5. Studies on health aspects.

Poultry

1. Introduction and testing of other species of poultry viz., ducks, quails, turkey etc.
2. Formulation of low cost economic rations for all types of poultry incorporating locally available by-products and waste products.
3. Studies on poultry diseases.
4. To evolve suitable management practices.

Fisheries

1. Evolving suitable farming systems involving pigs, cattle, poultry and fish.
2. Paddy-cum-fish culture using paddy varieties suitable for water logged conditions along with carps.
3. Composite fish culture in fresh water bodies.
4. Studies to assess the brackish water fish and prawn and their seed resources in Goa.
5. Studies on productivity of open inland waters of Goa and to evolve suitable fish production systems.

Annexure 1

Staff position: ICAR Research Complex and KVK

	Sanctioned	Filled	Vacant
(a) *Scientific*			
S-3	1	1	–
S-2	4	3	1
S-1	9	7	2
Sub total	14	11	3
(b) *Technical*			
Farm Superintendent	1	–	1
Technical Officer (Vet.)	–	–	–
Training Associate	4	3	1
Training Assistant	5	4	1
Farm Assistant	1	1	–
Junior Technical Assistant	6	6	–
Stockman	1	1	–
Sub total	18	15	3
(c) *Administration*			
Superintendent	1	1	–
Senior Clerk	2	2	–
Junior Clerk	2	2	–
Stenographer	1	1	–
Junior Stenographer	1	–	1
Sub total	7	6	1
(d) *Supporting*			
SS Gr. II	2	2	–
SS Gr. I	26	18	8
Sub total	28	20	8
(e) *Auxiliary*	2	2	–
Sub total	2	2	–
GRAND TOTAL	69	54	15

Annexure II

EXPENDITURE FIGURES
ICAR RESEARCH COMPLEX FOR GOA, (from 1985 to 1988)

Head	Non Plan (Rs. in lakhs)			
	1985–86	1986–87	1987–88	April-Dec. 88
Estt. Charges	5,77,561	7,68,914	9,84,398	9,73,508
T.A.	29,987	32,908	34,581	26,422
Recurring	3,90,614	4,27,493	2,13,697	2,43,209
Non recurring	1,01,684	50,436	16,797	97,394
Total	10,99,846	12,79,751	12,49,473	13,40,533
Head	Plan (Rs. in lakhs)			
	1985–86	1986–87	1987–88	April-Dec 88
Estt. Charges	–	–	–	–
T.A.	–	–	–	–
Recurring	56,158	55,684	1,44,609	48,648
Non recurring	2,49,702	6,41,674	1,76,640	1,04,851
Total	3,05,860	6,97,358	3,21,249	1,53,499

KRISHI VIGYAN KENDRA (from 1986 to 1988)

Head	1986–87	1987–88	April-Dec 88
Estt. Charges	1,35,000	2,96,995	
T.A.	6,000	18,514	4,526
Recurring	42,000	44,145	33,763
Non recurring	93,000	15,312	37,267
		21,432*	2,404*
Total	2,76,000	3,96,398	3,63,410

* Lab to land programme

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Annexure III

GOA'S AGRICULTURE IN FIGURES

General

Total geographical area	:	3,70,672 ha
Area under forest	:	1,05,295 ha
Total cropped area	:	1,52,895 ha
Cultivable waste	:	83,687 ha
Area sown more than once	:	9,714 ha

Crops

	Area (ha)	Production (tonnes)	Productivity (t/ha)
Rice			
Kharif	43,503	95,906	2.2
Rabi	10,182	28,509	2.8
Pulses	5,810	4,575	0.7
Sugarcane	1,700	86,000	50.5
Groundnut	1,000	1,503	1.5
Coconut	22,000	106 m.nuts	4800 nuts/ha
Mango	3,205	29,500	8.9
Banana	1,375	8,700	6.3

Animal Husbandry

	Population	Production
Cattle	1,20,304	–
Buffalo	42,317	–
Milch animals	49,620	2700 mt/year
Milk processed by Govt. Dairy	–	23,000 lit/day
Beef	–	45,000 t/year
Goat	22,704	15,000 t/year
Poultry	5,87,315	77.5 m eggs/year
Broilers	–	12,000 t/year

Fisheries

Coast line	...	105 km
Esturies	...	13,160 ha
Khazan inundations	...	18,500 ha
Brackish waters	...	3,250 ha
Total marine fish landing	...	33,070 t/year
Prawns	...	2700 t/year
Inland fisheries production	...	1500 t/ha