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A RESEARCH-BASED NGO IN INDIA: THE BHARATIYA AGRO-INDUSTRIES FOUNDATION'S CROSS-BRED DAIRY PROGRAMME

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CONTENTS

ACRONYMS

ADMAS	All-India Coordinated Research Project, Monitoring and Surveillance of Animal Diseases
AI	Artificial Insemination
BAIF	Bharatiya Agro-Industries Foundation
BIRC	BAIF Information Resource Centre
BRIAH	BAIF Institute for Animal Health
CMC	Central Management Committee
CPC	Chief Programme Coordinator
CRS	Central Research Station
DST	Department of Science and Technology
DNES	Department of Non-Conventional Energy Sources
FMD	Foot and Mouth Disease
GoI	Government of India
ICAR	Indian Council of Agricultural Research
INRA	Institut National de la Recherche Agronomique (France)
IRDP	Integrated Rural Development Programme
IVRI	Indian Veterinary Research Institute
KAU	Kerala Agricultural University

Acronymns (continued)

KDP	Karnataka Development Progress
NCL	National Chemical Laboratory
NDRI	National Dairy Research Institute
NGOs	Non-governmental organisations
PAU	Punjab Agricultural University
PTP	Progeny Testing Programme
PC	President's Council
R & D	Research and Development
RPC	Regional Programme Coordinator
RDO	Rural Development Officer
ZP	Zilla Parishad [District Council]

Abstract

BAIF Development Research Foundation's farm at Urulikanchan near Pune has been producing cross-bred dairy cattle for almost 20 years. In 1975 it began to experiment with semen freezing technology and has now produced almost 10% of the national cross-bred dairy herd, operating some 500 cattle development centres in which 1.5m families participate in six States.

The BAIF programme has expanded to embrace animal health (manufacturing its own vaccines) and nutrition (centred on multi-purpose tree species and by-product utilisation). It participates in several of the Indian Council for Agricultural Research All-India Coordinated Research Programmes, and has provided improved cattle to both State Agricultural Universities and ICAR institutes. Its cross-breeding programme has been externally evaluated as one of the most efficient in India, and links with central and state government programmes are set to expand.

I. BACKGROUND

(i) *Origins*

BAIF, a non-profit development research foundation, was founded on 24 August, 1967, at Urulikanchan, a small village about 35 kms from Pune. It seeks to raise incomes and employment among the rural poor through a judicious application of science and technology. From modest beginnings with a dairy cattle production programme, BAIF later diversified to embrace animal health, nutrition, afforestation, waste-land development and tribal rehabilitation and currently employs a staff of almost 3000. BAIF sees its development activities as being "based on technological research designed in response to field realities".

BAIF describes its work as "development research", perceiving that development and research go hand in hand to produce socially relevant and technically feasible projects. After two decades of experimentation, BAIF views development without research as outdated and research without development as merely academic. In its cross-bred cattle programme, which is the focus of this paper, BAIF pioneered research into aspects of artificial insemination (such as the freezing of semen) but, equally importantly, developed village-based delivery systems, known as cattle development centres, to carry out the inseminations, provide feedback on the progeny of individual bulls and supply related services in animal health care and nutrition.

Through excellence in problem-focused research, BAIF has gained recognition by several international and Indian Government agencies. This recognition has been instrumental first, in the forging of links between BAIF and the wider scientific community and second (as we discuss below) in enabling it to secure a funding base within and outside India. Thus, BAIF is recognised as:

- a Research Organisation by the Indian Council of Agricultural Research (ICAR) for conducting both ad-hoc and coordinated research;

- a Project-holder for bilateral assistance by the Government of India;

- a Research and Development Laboratory by the Department of Science and Technology (DST);

- a Project-holder by the Department of Non-Conventional Energy Sources (DNES), and Council for Advancement of People's Action and Rural Technology (CAPART);

- a Research institution by the State governments of Maharashtra, Gujarat and Karnataka;

- an Institute of Post-graduate Studies and Research by the Pune university; and

- a Project-holder by international agencies such as the United Nations' International Children's Emergency Fund (UNICEF); Ford Foundation; International Development Research Centre (IDRC); DANIDA; Action for Food Production (AFPRO) and Institute National de la Recherche Agronomique (INRA), France; Winrock International; the Asian Development Bank; the Government of the Netherlands and the Oxford Forestry Institute.

(ii) *Organisational set-up*

BAIF's trusteeship is vested in a Board of Trustees. The overall operational responsibility rests with the President Council which derives a strong technical and scientific support from the Advisory Council of Scientists. All policy-related matters and long term strategies, including capital purchases and large investments are the responsibility of the President Council (PC). The PC operates informally through discussions in small sub-groups at different points of time. Review of progress and corrective measures, if need be, are the responsibility of the Central Management Council (CMC) which consists of all the heads of divisions and associated organisations. The Regional Development Research stations located in Maharashtra, Gujarat and Karnataka are entrusted with the tasks of demonstration and training. BAIF's structure at village and area level is discussed in section II (ii) below, and in Annex 1.

BAIF currently employs over 3000 persons, of whom one-third are professionally qualified, including 8 at PhD level, 45 with other postgraduate qualifications, 170 graduates and a similar number of diplomates.

As BAIF expanded from its early core staff, it became necessary to recruit at middle and lower levels so that work initiated by the core group could be adequately carried out. In the process, BAIF inevitably became more bureaucratised in its structure.

Since the early 1970s, the recruitment of professionals to BAIF has undergone several shifts. The initial focus on veterinarians was, first, broadened to include other agriculture graduates. Difficulties in retaining graduates in the face of attractive offers from public sector and private commercial companies led to a policy of recruiting technicians educated up to matriculation level and providing them with intensive training. This comprises a 6-week course at BAIF, followed by a 2-month supervised attachment to a cattle development centre. The recruit's performance is evaluated after each of these stages, and on completion of a further 6-month probationary period during which he takes over responsibility for a centre.

(iii) *Initiation and management of research programmes*

In such a large organisation as BAIF, clear procedures for the preparation of new programmes, and their monitoring and evaluation are essential. BAIF combines organisational requirements with flexibility in ways which may prove instructive to other organisations. For instance, on receiving a request for research, the BAIF President will pass it to the appropriate department which prepares a proposal through a series of informal consultations which often cross disciplinary and departmental boundaries. The proposal is examined by the President Council which seeks to identify a suitable sponsor and then serves as first point of contact for all subsequent correspondence.
Publication of the results of research by BAIF scientists consolidate its scientific reputation and so are encouraged. Submissions for external publication pass through rigorous review by, first, the author's peer group and subsequently, by the President Council.

This paper reviews BAIF experience in three related areas of R & D: cross-breeding for dairy improvement, animal health and animal nutrition. It seeks to draw out the organisational and institutional issues faced by BAIF, especially in its relations with public sector research and extension institutes.

II. CROSS-BREEDING FOR DAIRY IMPROVEMENT

(i) *Evolution of the cross-breeding programme*

BAIF's interest in raising the productivity of dairy cattle began with the work of its President, Manibhai Desai, in the 1950s in a nature-cure ashram at Urulikanchan, a village 35 km from Pune, and now the location of BAIF's research farm. Faced with shortages of milk for the ashram's patients, Desai studied bovine physiology and anatomy and introduced innovative practices of breeding, nutrition and health care. Despite the fact that the ashram's cattle went on to win All-India milking competitions for indigenous cows, Desai recognised that genetic factors limited potential yields and so in the early 1960s embarked on a programme of cross-breeding within a small herd. Encouraged by its success, he established BAIF in 1967 and began to seek funding from internal and external resources for a wider effort.

In India, of the 26 indigenous breeds of cattle, only four are recognised as milch breeds: Sindhi, Sahiwal, Gir and Tharparkar. Fourteen breeds are recognised as primarily draught animal breeds, the remaining eight being dual purpose. A milch breed yields 900-1200 litres of milk in one lactation of 240-280 days. The dual and draught-purpose breeds yield about 600-800 litres and 150-400 litres respectively. The major limitation, however, is that less than 20% of the cattle population (191 million at the 1982 census) are well-defined. The remainder are categorised as "nondescript", with an average milk production of 250-300 kgs per lactation of 180 days.

The BAIF cross-breeding programme is based on the fact that germplasm from exotic breeds induces faster reproduction, early maturity and high milk production in the nondescript cow. A cross-bred cow at village level yields 1600-2200 litres per lactation of about 250 days (Deore, 1990). However, those with a high proportion of exotic blood are more prone to disease than indigenous cattle. The optimal percentage of exotic blood therefore has to be a carefully researched compromise between yield and resilience, and will vary according to local management conditions eg. the ease with which suitable health care can be administered, or suitable nutrition supplied.

At the time when BAIF decided to launch its cross-breeding programme, AI facilities were offered at government veterinary centres, but relied on liquid semen technology, the viability of which could be sustained only over a maximum of 72 hours. It was therefore very difficult to make semen

availability coincide with oestrus in cows. Additional disadvantages included the limited number of inseminations possible from a single batch of semen, and the fact that cows generally had to be walked to the government centre for insemination, thus reducing the prospects of successful insemination through the stress induced. Furthermore, little follow-up was provided by AI services in improved nutrition and health care.

In the light of these considerations, the cattle development programme was designed with the following specific objectives:

* to develop cross-breeds exhibiting optimal combinations of improved milk yields and resilience through the on-farm use of high quality frozen semen of proven sires;

* to establish the practice of examining each inseminated cow for early and accurate pregnancy diagnosis;

* to render timely guidance for the care of pregnant cows and newly born cross-breeds in nutrition, health and management;

* to develop a low cost non-conventional composite cattle feed from indigenous resources, especially for use in the drought-prone areas;

* to identify, develop and make available good quality drought-resistant fodder and forage crops;

* to impart training to the BAIF personnel, other professionals and farmers in various aspects of cattle development; and

* to conduct applied research in areas and/or on specific problems related to the cattle development so as to achieve these objectives.

To realise these objectives and support its field activities, BAIF decided to establish a central Research Station (CRS) at Urulikanchan, and a network of cattle development centres to meet local needs. Among the CRS's facilities were to be included a frozen semen bank and laboratories for nutrition research, fodder and forage development and animal health research.

The establishment of BAIF in 1967 marked the beginning of a period of intense activity to secure land (eventually donated from local councils, to

design and construct buildings (with the assistance of the India Dairy Corporation), to identify sources of staff salaries (from ad hoc donations by commercial companies in the early period) and to travel abroad in order to acquire the breeding stock (initially 200 heifers from Denmark) and the equipment and knowledge for frozen semen production on a commercial scale.

BAIF felt the best way to create cross-breed technology awareness among farmers was through demonstrations. The Panjrapoles or Goshalas were chosen for the purpose. Funded largely by public donations, these institutions are established to care for discarded cattle. BAIF offered techno-managerial services, including cross-breeding, to these institutions, the cattle, milk and other by-products remaining the property of Panjrapoles. The strongly positive public response to these animals led to the establishment by BAIF of local centres for dissemination of the technology and training in its use.

In the initial years, BAIF received semen from external sources, but to reduce costs and achieve greater control over the material, it established a frozen semen laboratory in 1975 with DANIDA assistance. After commissioning the equipment and producing a pilot run of some 50,000 doses of semen, with Danish technical assistance, the laboratory has subsequently been operated by BAIF.

The semen freezing laboratory of BAIF meets international standards for quality control. The annual production of semen in recent years stands at about 1.5 million doses, the majority of which is used in BAIF's own cross-breeding programmes at village level. Any surplus doses are supplied to various State government institutions, milk unions and private breeders. Simultaneous to production, research activities have been conducted on the following aspects:

* performance of semen in the field
* frequency of semen collection
* chemical composition of semen
* effect of different feeding levels on production
* freezing of cross-bred semen

* semen and draught performance of cross-bred bulls.

BAIF has a unique advantage over government organisations insofar as three functions - research, dissemination and implementation - which are often administratively and institutionally distinct in the public sector are integrated into a single organisation in the case of BAIF. BAIF now has over 500 local cattle development centres in six States. Their origins lie in a model developed at the Pravranagar Sugar Cooperative Factory in Maharashtra in the early 1970s. Farmers (ie. cooperative members) were assured such services as artificial insemination; pregnancy testing; clinical diagnosis and training in calf management. In return, a farmer was required to pay one rupee per animal per month. The development centre was designed to have 1500-2000 breedable cows within a radius of 10-12 kms.

Each staff member at the centre sought to carry out ten AIs per day with a 60-70 km round trip. The initial conception rate was estimated at about 40% and has now risen to over 60% Further details of the mode of operation of these centres is provided below in the Karnataka case study (Annex 1). Starting from six centres in 1970-71, BAIF had 35 centres by 1976-77 with the sponsorship of the sugar cooperatives. Various dairy societies and milk federations also came forward with offers of sponsorship. Cattle development centres were also established in Gujarat with the help of Sadaguru Seva Sanga Trust, a voluntary agency promoted initially by Mafatlal Mills. In this early period, sponsorship was such that BAIF's cattle development programme was confined to the irrigated areas inhabited by relatively rich farmers.

In the mid-1970s BAIF approached the Ministry of Agriculture and Rural Development and the Planning Commission for help in extending the programme to low-income areas. Following a GoI inspection of work at Urulikanchan, it was agreed that the BAIF approach to field-level dissemination should be replicated under the Integrated Rural Development Programme (IRDP). Under this agreement, a minimum of 51% of the households included in BAIF's programme were to be selected from those below the poverty line. Verbal assurances were given of IRDP sponsorship for a minimum of 10 years for each centre under the programme, pending regular performance reviews.

On this basis, BAIF established 400 cattle centres in Maharashtra during 1976-77 which the IRDP financed for two years. However, political changes in the State resulted in the stoppage of funds against which BAIF,

in the absence of a written agreement, had no redress. BAIF managed to sustain the programme for two more years from its own funds before deciding to close down these centres and concentrate on other states.
The areas proposed for cattle developed are generally identified by the respective State government. BAIF examines them against the following criteria:

* Transport facilities in the operation area

* Minimum living amenities at the proposed headquarters of the centre

* Communication facilities

* Educational services such as schools, colleges etc.

* Accessibility

* Cropping pattern and agricultural production

* Milk marketing avenues

If there are substantial shortcomings against these criteria, BAIF will either negotiate an increased charge per participant or request the identification of a different area.

Performance targets for each centre are fixed under a tri-partite agreement among the BAIF, and State district administrations. The targets are reviewed at the state level meetings twice a year. The farmer is not required to pay for AI services. Funding is through a range of development programmes and its level is linked to the performance of individual centres.

BAIF now has some 500 cattle development centres in six States covering 800 villages and 1.5 m families. To facilitate service provision, villages tend to be selected in clusters. BAIF also organises its work at village level in a highly structured fashion:

cattle development centres, managed by a rural development officer, are the smallest operational unit, catering for 1500-2000 breedable cows in a 10-15 km radius and responsible for AI, extension programmes and field level data collection.

area-level programmes coordinate the activities of several centres and are responsible for implementing demonstrations and training.

zone-level programmes typically cover 5 areas. They act as resource centres for area programmes and follow up the needs and opportunities identified during monitoring.

regional-level programmes coordinate input procurement for area and zonal programmes and are responsible for social science surveys of field activities and documentation.

(ii) *Progeny testing within the cross-breeding programme*

The Progeny Testing Programme (PTP) is an ad-hoc project on a coordinated basis, sponsored by ICAR. Other participating institutions include the Punjab Agricultural University (PAU), Ludhiana and the Kerala Agricultural University (KAU), Trichur. The programme started in 1985, and aims at assessing the performance of progeny to help in the selection of bulls. It is an important element of AI quality control. The BAIF programme involves recording the milk yields of over 3000 cows, standardising the procedures of data collection, and identifying and estimating the contribution of non-genetic factors to performance. Few public sector R & D agencies have access to sufficient cows in AI programmes to be able to participate in this programme. Even PAU and KAU are operating through the respective State government animal husbandry departments and so have to use data of sometimes dubious reliability. Data unreliability affects the selection of bulls, and, in turn, the performance of the next round of progeny. Thus, the average milk yields recorded among the BAIF, PAU and KAU cows under the PTP were 2400 kg/yr, 2100 kg/yr and 1300 kg/yr, respectively. Under a semen exchange programme recommended by the Indo-US Sub-commission (GoI, 1988), farmers showed a distinct preference for semen provided by BAIF over that of PAU and KAU.

(iii) *Research sponsorship and relations with the public sector*

In parallel with its efforts to obtain resources from donors, BAIF simultaneously prepared a number of R & D proposals for funding from internal sources, especially from industrial corporations. GoI had already made a provision by which private companies could claim 100% income

tax relief on donations made towards the cost of approved R & D. This is subject to the stipulation that the organisation conducting the R & D should be equipped with adequate infrastructure and competent professionals. This had to be certified by an appropriate authority, which in the BAIF's case was the Indian Council for Agricultural Research. The initial request for recognition from ICAR was not granted as BAIF at the time did not meet ICAR's stipulation that it should have an aggregate herd strength of at least 6000 cows. Manibhai Desai appealed to farmers and panjrapoles for support in acquiring more cows. In response, a total of over 11,000 cows entered the BAIF programme - more than enough to ensure that BAIF in 1969 became a recognised research institute for the purposes of tax exemption on donations, whilst BAIF has succeeded in obtaining funds for numerous research studies under this scheme (Annex 4), numerous problems remain (Annex 2).

Much early funding under this arrangement came from the Mafatlal group of industries which helped in developing infrastructure at Urulikanchan and provided professional consultants to build up an organisational structure. These were the first steps in transition from a one-man organisation to a professional corporate structure.

The rate of tax relief on specific R & D projects approved by the Government was raised to 133 percent in the mid-1970s. BAIF subsequently received funds from Asian Paints, for research projects in the following areas during 1978-83:

* Genotype/environment interaction in exotic and Indian cattle

* Semen freezing production vs importing of semen

* Utility of cross-bred bulls

* Effect of protein and energy levels in feeding of cross-bred bulls on semen quality

* Evaluation of trace element status in blood of dairy cattle and bulls.

Similar research was being conducted by ICAR, NDRI and the SAUs also. What was innovative about BAIF's research in these areas is that, perhaps for the first time in India as far as animal production was concerned, it represented a judicious combination of on-station and on-farm research.

ICAR approved BAIF's research designs in these areas, and conducted technical monitoring, frequently carrying out unannounced inspections of data and methods. Close interaction with ICAR allowed conventional wisdom to be challenged in several ways. For instance, the ICAR view in the 1970s had been that imported semen performed better in AI than locally obtained semen. BAIF's data on conception rates and progeny testing demonstrated that this was not the case at small-farm level. BAIF's data withstood the scrutiny of a high-level ICAR team, and their conclusions were upheld, albeit after almost 3 years of debate with ICAR.

III ANIMAL HEALTH RESEARCH AND DEVELOPMENT

(i) *Vaccine production*

Although not as susceptible as pure exotics to disease, cross-bred cattle are more susceptible than indigenous stock, particularly to food and mouth disease (FMD). A multi-national company was the only organisation marketing FMD vaccines in India in the early 1970s. However, compared with the Planning Commission's estimated requirements of 50 million doses per annum, the company's production was a mere one million doses at a price (Rs. 14 per dose) that was prohibitively expensive for most farmers.

In response, a health coverage programme was conceived by BAIF, an integral part of which would be FMD vaccine production. The Bharatiya Research Institute for Animal Health (BRIAH), a wholly owned subsidiary of BAIF, came into existence in 1974-75 at Wagholi, Pune, and was equipped in 1976 through a bilateral programme with DANIDA.
BAIF's originally envisaged production capacity was 3.2 million doses per year of FMD vaccine. A subsequent review by DANIDA recommended increasing the production capacity to about 8 million doses, a target which was reached by the mid-1980s. By contrast, an ICAR institute (the Indian Veterinary Research Institute) which had received similar equipment from DANIDA in the 1970s is still producing under 1m doses annually. Several examples of BAIF collaborative agreements with Indian and foreign research centres illustrate how it was able, through problem-focused research, to introduce a number of improvements to vaccine production technology.

Simultaneous to equipment procurement, for instance, BAIF arranged for training for 40 of its professionals with the Institute National de Recherche Agronomique (INRA) of France. The training, however, was broad-based

and covered subjects, such as semonology, vaccine production, parasitology, immunology, virology, gynaecology, dairy management and library science. This training helped not only in manufacturing FMD vaccines but also in undertaking research aimed at producing other vaccines and biologicals, such as *rhizobia* for enhancing crop yields.

At present, altogether 65 different biological products are manufactured, a select list of which is presented in Annex 5, with an annual turnover for 1989-90 of Rs. 50 million. The future possibilities of developing vaccines for sheep-pox, goat-pox, infectious bronchitis, infectious laryngo-trucheitis and infectious bursal disease, are currently being investigated by research. A disease surveillance programme has been initiated to standardise the field reporting system for screening and monitoring diseases. About 50,000 bovines in 50 villages are under observation for detecting disease outbreak and status and the associated economic losses. This programme is expected to help in the forecasting of disease outbreaks so that preventive measures are planned. As a part of the programme, 8,175 farmers have been trained in disease surveillance and control through 226 training programmes.

The following technologies have been developed by BRIAH, Wagholi, in the last 15 years:

* Local production of such costly (hitherto imported) vaccine potentiating agents as aluminium hydroxide gel and purified fraction of saponin.

* Development of shake culture (fermenter) technology for 3-dimensional growth of micro-organisms for increase in biomass production.

* Development of vaccine concentration and freeze-drying technology for efficient preservation and long duration storage of vaccine and other biologicals.

* Development of stabilised diluents for reconstitution of freeze-dried vaccines.

* Development of standardised biofertilisers, namely *rhizobia* for different legumes, deploying fermenter concentration and freeze-drying technologies as well as sterilised packaging for distribution over long distances.

* Standardisation of delivery systems for biological products through innovative cold chains for assured quality throughout the marketing chain.

* Development of large-scale production technology for essential veterinary pharmaceutical formulations for clinical and systemic conditions in livestock.

* Extension of animal health field operations through the Animal Disease Surveillance and Control Programme.

In the process of developing technologies, BAIF has developed linkages with many national and international agencies:

The Indian Agriculture Research Institute, New Delhi

The Department of Non-Conventional Energy Sources (DNES), GoI, New Delhi

The Department of Bio-Technology, GoI, New Delhi

The Maharashtra Association of Cultivation Science (MACS), Pune

The National Chemical Laboratory (NCL), Pune

State Agricultural University, Maharashtra
Dundee University, Scotland

The Institute of Terrestrial Ecology, Edinburgh Research Station, Scotland

The Institute National de la Recherche Agronomique (INRA), France.

The linkages have helped in developing technical competence and improving financial resources. They are frequently marked by joint meetings such as the BAIF/INRA seminar on recent advances in diary cattle production from 11 to 13 February, 1989. Held at Urulikanchan and Wagholi, the seminar provided a forum for exchange of information among scientists, administrators, research organisations, voluntary agencies and financial institutions.

BRIAH products are being used by BAIF throughout its operational areas. Almost all the State governments and biological institutes obtain their requirements from BRIAH. Additionally, BRIAH has exported vaccines since 1980 to a number of countries - Nigeria, Uganda, Yemen, Cambodia, Thailand, Nepal, Burma, Bangladesh and other countries, through FAO and UNDP.

BRIAH vaccines appear to have had a strong impact on the local market. For instance, the price of FMD-vaccine manufactured by a commercial company was Rs. 14 per dose in the early 70's, which was reduced to Rs. 7.00 in the late 1970's and to Rs. 3.50 currently in response to BRIAH's entry into the market. Even at these reduced prices, demand is 15m doses as against an estimated requirement (for comprehensive FMD control) of 50m doses. However, it is unlikely that this "gap" will be closed by further price reductions alone (towards which BRIAH is working). It will also require country-wide extension and marketing campaigns which, given the limitations of public sector veterinary extension agents, remain weak in many areas.

As part of their vaccine production programme, BRIAH and BAIF conducted research into the possibility of local production of aluminium hydroxide gel-adjuvant, which serves to harbour the antigen. This previously had to be imported. BAIF/BRIAH successfully developed a technology for manufacturing this medium. The product is now made available to all the biological institutes in India and saves approximately Rs. 10m in foreign exchange annually.

The costs of vaccines to farmers were reduced by BAIF research on vaccine production, but also by parallel work to reduce the cost of thermally insulated packaging. Research on polymers conducted by the National Chemical Laboratory (NCL), Pune, had led to a moisture sustaining product, *Jalashakti*, intended for use in plant production. BAIF used *Jalashakti* to develop a low-cost package material, as a result of which the cost of the package came down from Rs. 40 to Rs. 7 per 200 doses of FMD vaccine. BAIF promptly communicated this to NCL which is now trying *Jalashakti* for usage in human vaccines. Successful collaboration in this area has led NCL and BAIF to collaborate further in a variety of research projects on bio-technology.

(ii) *Animal disease monitoring and surveillance (ADMAS)*

The conventional disease reporting system in India is strongly hierarchical. Field-level veterinary officers report the outbreak of disease to the district officer who communicates it to the Director of the State Animal Husbandry Department. Information from various States reaches the Commissioner of Animal Husbandry, Ministry of Agriculture, GoI. It normally takes 3-6 months for the Animal Husbandry Commissioner to receive information of a disease outbreak. A further one to one-and-a-half years may elapse before information is compiled from various states and disseminated to diagnostic laboratories - SAUs, R & D agencies and biological institutes - for future action. The under-reporting of disease has been common. It is against this background that ICAR initiated an All-India Coordinated Research Project, Monitoring and Surveillance of Animal Diseases (ADMAS). This is a disease intelligence activity studying the interaction between ecological system and pathogenesis for help in forecasting (and subsequent preventive measures) through a national network.

BAIF has played a vital role in launching ADMAS. Its origins lie in an annual workshop of the All-India Coordinated Research Project on Foot and Mouth Disease in Madras in 1984, to which BAIF was invited. ICAR followed up BAIF's suggestion for a disease intelligence network and constituted a sub-committee which included BAIF representation. The subsequent workshop held in 1985 helped in shaping the proposal, and ADMAS was launched. Initially, ICAR invited IVRI to coordinate the project at the All-India level, but both IVRI and the National Dairy Development Board declined to take on the substantial organisational responsibility. The participating institutions in the first year were the Veterinary Biological Research Institute, Hyderabad; the Institute of Animal Health and Veterinary Biologicals, Bangalore; and PAU, Ludhiana, with an ICAR appointee as coordinator based at Bangalore. BAIF was invited by ICAR to participate in the research programme in 1987.

(iii) *Animal nutrition research and development*

Cereal straw has conventionally been a major dietary component of Indian cattle. However, it has numerous nutritional shortcomings, including: low energy and protein; low digestibility of dry matter; deficiency in calcium, phosphorous and trace elements; low carotene content; and high levels of crude fibre, cellulose, hemicellulose, lignum and silica. Although

technologies exist for overcoming these difficulties - BAIF, for instance, as part of an ICAR All-India Coordinated Research Project, developed methods of improving the nutritional quality of straw by over 20% through treatment with 4% urea - such methods are costly at farm-level. In another ICAR-sponsored project, BAIF developed milk replacer using extracts of leguminous leaves for feeding calves. An ICAR-approved Asian Paints sponsored project enabled BAIF to evaluate the trace element status in blood of dairy cattle, in fodder crops and in soils. BAIF is one of the 15 participating institutions in the ICAR's All India Coordinated Research project on forage crops. The project has been instrumental in stimulating the inclusion of production of edible by-products as a criterion in screening new crop varieties.

More substantial BAIF efforts focus on research into non-traditional fodder crops and multi-purpose trees to meet the following requirements:

* year-round production
* minimal managerial requirements
* high crude protein and dry matter content
* easy digestibility
* no toxicity
* grows well under drought conditions and on degraded wastelands.

BAIF was among the first organisations in India to conduct trials on *Leucaena leucocephala* as a multi-purpose tree. Planting material was obtained from Hawaii for observation plots in 1976, and following the assembly of technical information (including a visit by senior staff to the Philippines) BAIF progressed to varietal trials and large-scale multiplication on farmers' fields.

Concern had been expressed in the scientific literature for some time over the possibilities of mimosene or dihydroxypyridine (DHP) toxicity in both ruminants and non-ruminants as a result of feeding high concentrations (over 30%) of *leucaena* in animal diets. BAIF therefore instituted a trial in which bull-calves were fed exclusively on *leucaena* for over 2 years. No ill-effects were observed. After visiting this trial in 1978-79, scientists from CSIRO, Australia, initiated joint experiments with the University of Hawaii

and succeeded in isolating DHP-degrading bacteria from the rumen of goats maintained on diets of *leucaena*. A subsequent survey suggested that these naturally-occurring bacteria are found in Hawaii, Indonesia, Philippines, India and several other countries, but absent from Australia, Papua New Guinea and parts of Africa. In 1982, the bacteria were successfully introduced to Australia and by the mid-1980s a series of papers had been published internationally outlining simple methods for testing for mimosene and DHP toxicity, and for introducing the necessary bacteria into areas where persistent toxicity indicated their absence.

Despite the pioneering efforts of BAIF to test for toxicity through long-term feeding trials in India, and despite the publication of some 300 research papers on mimosene or DHP toxicity in the 1980s, articles are still appearing in India (eg. in "Wastelands News", 1989) conveying alarmist views of toxicity problems in *leucaena*, and suggesting that "the possibility of presence of micro-organisms [ie. toxin-degrading rumen bacteria] is highly controversial".

This episode illustrates numerous problems within the Indian scientific establishment:

i) its reluctance to accept the findings of research conducted by an NGO

ii) its apparent incapacity to test for the presence or absence of relevant bacteria in India through large-scale surveys

iii) the resultant absence of clear guidelines published under the auspices of the ICAR on the toxicity "problem"; its incidence; detection methods and methods of stimulating the natural spread of relevant bacteria.

iv) the low-level of familiarity among many scientists, whether in government institutes or NGOs, with current international literature and the limited ability to place their own work in this wider analytical context in order to avoid uninformed (and often alarmist) conclusions

v) a tendency to make inappropriate suggestions for future research - the "Wastelands Development" article suggested as a priority the development of low mimosene varieties of *leucaena*, whereas work elsewhere has shown that no stable

lines of *leucaena* are known with less than 2% mimosene (against 4% - 5% normally), which is not low enough to avoid DHP toxicity in animals lacking the appropriate bacteria.

Overall, the episode illustrates the capacity of BAIF to apply research to specific issues in India in a fashion well-informed by wider literature. It underlines the value of the Information Resource Centre established at BAIF (Annex 3).

This work on multi-purpose tree species has been supplemented by investigations into soil micro-organisms (specifically, *rhizobium* culture) capable of promoting nitrogen fixation under conditions of low soil fertility such as are found eg. on wastelands. Drawing on previous work conducted at CSIRO (Australia) and on training at INRA (France), a BRIAH team succeeded in developing distinct *rhizobium* culture suited to acid and alkaline soils. BAIF's *rhizobium* suitable for *Leucaena* has been officially recognised by the GoI, and over 0.5m doses have been distributed. Further work in this field is being conducted on *mycorrhiza*, and inoculants have been developed for a range of oilseed crops. The Ministry of Agriculture has provided funding for the large-scale production by BAIF of biofertilisers and inoculum.

V CONCLUSIONS

BAIF's cross-bred cattle development programmes, with related nutrition and animal health components, some 1.5 m households in 6 States of India and produces some 200,000 cross-breds through AI each year. In aggregate, it has produced almost 10% of the current national stock of some 9 m cross-bred dairy cows.

Its particular advantages as an NGO include:

i) the integration of research, dissemination and implementation into a single organisational structure

ii) the ability to tailor research to field-level problems in an integrated fashion. The clearest illustration of this is the integration of breeding, nutrition and health care.

iii) strong emphasis on feedback - both positive and negative - from village level. The progeny testing programme is a highly structured and quantified example of feedback and has been managed better than those of many government institutes concerned with AI (GoI, 1988). Other, less-formalised, examples of feedback exist which have influenced subsequent research.

BAIF's relations with government have been mixed. On the positive side, many BAIF senior scientists command wide professional respect, and have good contacts with ICAR institutes, not least because some of them worked there previously. These strengths have been instrumental in gaining the necessary official recognition for BAIF to receive private sector donations under tax-relief schemes. Similarly, BAIF's strengths in integrating research with implementation have brought substantial funding from State-level development programmes. At the scientific level, certain BAIF findings (eg. concerning the acceptable performance of locally produced semen) have been accepted by ICAR, and some of BAIF's proposals (eg. for disease monitoring) have subsequently been taken up.

There are, however, two negative aspects to the relationships between BAIF and government:

First, learning by BAIF from the public sector has been limited, partly because research coordination in India continues to be inadequate, partly because of the limited relevance of much work conducted at ICAR institutes and in Agricultural Universities to the practical context of development. This disjointedness becomes particularly costly in the more advanced techniques currently being researched. Thus, BAIF plans to research Multiple Ovulation Embryo Transplant technology, but so do several other institutes, and the benefits of coordination in a way more imaginative than that characterising most All-India Coordinated Research Projects seem self-evident.

Second, there remains in some government research institutes considerable mistrust of work done by BAIF. Some see it as primarily a development organisation lacking research pedigree. Certainly, the higher priority given by BAIF to achieving implementable results than to producing publishable material is in marked contrast to behaviour patterns in many Indian public sector research institutes. There appear, however, to be few (if any) examples of sub-standard research conducted by BAIF.

In many respects, BAIF is an unusual NGO - exceptional in the charismatic qualities of its founder, and in the research capability that it has been able to develop. Some would argue that these characteristics cannot be emulated by other NGOs. But such an assessment of BAIF is excessively restrictive: perhaps the most important difference between BAIF and other NGOs lies in its confidence in technological interventions as a means of achieving sustainable improvements in livelihood, with minimal attention to the social organisational issues central to the philosophy and practice of many NGOs. Whether such improvements reach the rural poor and can, in fact, be sustained, requires a fuller evaluation than can be provided here, it even the *possibility* that it may have done so suggests that two distinct lessons can be learnt from BAIF:

- NGO programmes seeking technical improvement in agriculture (and there seems little assurance that social organisation and conscientisation programmes - though important - are *alone* sufficient to achieve livelihood improvement) require professional skills and careful, systematic monitoring and evaluation. If they cannot provide them from their own resources, NGOs must carefully consider whether, and, if so, from where, such skills can be drawn in from outside. They must also consider the structural and organisational measures necessary for implementation of systematic procedures.

- government research and extension services will achieve less than their potential impact unless they are organised increasingly around problem-oriented research, involving greater collaboration among disciplines and stronger integration within the research-dissemination-implementation chain.

These are likely to be the most enduring lessons of the BAIF experience.

* * * * *

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Annex 1: DELIVERY OF SERVICES: THE KARNATAKA EXPERIENCE

Normally a cattle development centre is established within six months of the release of funds. Simultaneously, a Rural Development Officer (RDO), is recruited to run the Centre. To facilitate supervision and management centres are established normally in a cluster, and rarely in isolation.

A case study of the establishment and operation of centres is provided by Thadasur village in the drought prone southern part of Karnataka. Before the establishment of a local Milk Union (federated to Karnataka Milk Federation), in 1985, nondescript cows were kept mainly to ensure a flow of bullocks for draught. As marketing possibilities improved, the demand for cross-bred cows rose and BAIF started operations there in 1986.

BAIF's RDO initially met the village leaders and, later made a door to door campaign, thus establishing contacts with every household in the village. Meetings were held in groups during which slides and film shows were shown to create awareness about AI. Discussions with groups of women were also held. Ten prominent villagers were taken to a private dairy farm in Bangalore having 600 cross-bred animals and within two days were convinced of the utility of AI. However, awareness creation became much stronger as cows began to be inseminated within the village itself.

The RDO is provided with a motor cycle and is allowed to prepare his own programme. A call register is kept at the Centre. A farmer whose cow has come into heat goes quickly to the Centre to register his "call". This must be attended to by the RDO within 12 hours. Up to three inseminations per cow are allowed for any given pregnancy. In 60% of cases, animals become pregnant in one service; but 20% require two services; and 10% three services. The remaining 5% are classed as "problematic". An RDO makes a minimum of three visits: the first for the AI; the second for pregnancy testing and the third after calving. In the meantime, farmers are given instruction on preventive health care, nutrition and management. The RDO also offers to provide preventive health care through vaccinations from BAIF against payment. A farmer paying Rs. 16 per year per animal is entitled to vaccinations administered four times in a year to take care of five important diseases. Pathological examinations in addition to vaccinations are charged at Rs. 35. A comprehensive diagnostic health coverage costs Rs. 60. The normal milk

yield from cross-breds in this area is 6-8 litres per day with a lactation period of 9-10 months.

Programme Monitoring

In the majority of cases, the RDO makes seven visits to a household each year. These allow detailed records to be compiled on AI, pregnancy testing, calving and health profile. The centre's activities are monitored both internally (by BAIF) and externally (by the district and state administrations). Copies of the centre's monthly reports are sent to the Area Programmes Officer (APO), who coordinates the activities of 3-10 centres. From the APO, reports reach the Regional Programmes Coordinator (RPC), who is entrusted with the responsibility of a zone, consisting of 4-5 districts. The RPC conducts monthly meetings of APOs and RDOs to take stock of and review the situation. He also liaises with BAIF and the Government bodies at the state level. Each state has a chief programme coordinator (CPC) to monitor the activities of RPOs; there are nine RPOs in Karnataka.

Simultaneously, monthly reports are sent to the Director, Animal Husbandry Department, with copies to the Development Commissioner; Secretary, Department of Rural Development and Panchayat Raj; and Secretary, Department of Animal Husbandry, Forestry and Fisheries of the Government of Karnataka. A copy is also sent to the Zilla Parishad. BAIF is specially invited to attend the Karnataka Development Progress (KDP) meetings held every month by the ZP. The meeting is also attended by all the district officers of the line departments. BAIF is represented by either APO or RPO. The progress of BAIF activities in the district are discussed at the KDP meetings. While the KDP is meant to discuss all the development activities in the district, the quarterly meetings are held exclusively to review the BAIF's activities; these review meetings are attended by the Chief/Assistant Secretary of ZP, the Deputy Director of Animal Husbandry, and the District Veterinary Officer.

Based on the reports furnished by BAIF, the Animal Husbandry Department and ZP conducts an in-depth animal-by-animal inspection. The farmers are questioned whether the AI was done, whether the services were rendered at the door and whether any payment was made for the services. The Animal Husbandry Department inspects twice a month - the first, independently and the next in the presence of a RDO. This has kept BAIF on the alert, and so minimised errors in reporting.

Annex 2: FUNDING DIFFICULTIES FACED BY BAIF

BAIF faces two types of difficulty in its relations with government on funding.

First, its efforts to obtain sponsorship from private companies are sometimes bypassed because notification by GoI of forthcoming R & D sponsorships tend to be circulated among a small group of organisations from which BAIF is omitted. Vigilance by BAIF is therefore necessary if it is not to miss these opportunities. Where BAIF has taken the initiative in proposing sponsorship for a particular research area, it has frequently found GoI institutes reluctant to see sponsorships channelled to "outside" organisations. Furthermore, BAIF has to register as a government-recognised institution every year. In some cases the granting of this approval has been delayed substantially - in one case, by 11 months within the year concerned, thereby jeopardising funding possibilities within that year. Second, BAIF frequently seeks funding from international organisations given the high levels of funding and flexibility that they offer. However, the required procedure of obtaining "no-objection certificates" from relevant Ministries and Departments at national and state levels is time-consuming and prone to failure. Difficulties from external funding agencies are also encountered from time to time. One agency insisted, for instance, that no fewer than 35% of BAIF employees should be women in the major categories of employment. This posed particular problems for the staffing composition of development centres since it is extremely difficult in India to find women willing to work on AI.

Annex 3: BAIF INFORMATION RESOURCE CENTRE (BIRC)

BAIF Information Resource Centre (BIRC) has been set up to provide information support services to professionals within and outside BAIF. It is supported by a Rs. 50m (£1.4m) grant from IDRC. BIRC has three specialised cells: i) library and information, ii) computer and electronic data processing and iii) communications and publications. Data bases consisting of bibliographic as well as management information are being created. An integrated data-base using UNESCO's CDS/ISIS package is used for information retrieval. A monthly indexing bulletin carrying abstracts of selected articles, newspaper clippings, new library accessions and news on training programmes, conferences, seminars and workshops is brought out by BIRC. Acquisition of computerised telex facilities and a pass word to global DIALOG data bases enable on-line literature searches. The computer and EDP services provide software and systems development support to the computer users of different departments. BIRC also envisages development of appropriate communication aids for training. Some 400 NGOs have already approached BIRC for its information services and plans are in hand to create a register of affiliated NGO-users.

Annex 4: SPONSORED RESEARCH PROJECTS

Indian Council of Agricultural Research

1. Progeny testing of young crossbred bulls in rural areas
2. Research on development of large-scale production technology of freeze-dried vaccines
3. All-India Coordinated Research Project on Development of System of Surveillance, Monitoring and Forecasting of Important Animal Disease
4. All-India Coordinated Research Project on By-products
5. Bio-conversion of Agricultural Crop Residues. Co-sponsor: Government of the Netherlands
6. All-India Coordinated Research Project on Forage crops

Planning Commission, Government of India

7. Survey on economics of fodder production

Department of Non-conventional Energy Sources (DNES), Government of India

8. Field trial on the utilisation of agricultural wastes for biogas production
9. Cultivation of *Jatropha curas* for use as diesel
10. Isolation and characterisation of *Rhizobium Species* suitable for Multipurpose Nitrogen Fixing Trees (MPTS)
11. Energy Plantation Demonstration Project, Lakkihlli, Karnataka
12. Raising energy plantation at Zamp, Gujarat
13. Rising fuel-cum-fodder plantation at Bakrol, Gujarat
14. Raising fuel and fodder plantation at Nagarala, Gujarat
15. Energy plantation demonstration at Kanchanwadi, Maharashtra
16. Energy plantation demonstration at Wagholi, Maharashtra
17. Raising fuel and fodder plantation at Kadod, Gujarat
18. Isolation and characterisation of *Rhizobium species*

Annex 4 (continued)

Gujarat Energy Development Agency (GEDA)

19. GEDA rural energy programme at Bansda, Gujarat

National Wasteland Development Board
Government of India

20. Development of wastelands in Bansda Taluka

Indian Petrochemical Corporations (IPCL)

21. Afforestation and horticulture programme at Nagothane, Maharashtra

Danish International Development Agency (DANIDA)

22. Animal Disease Surveillance and Control Project
23. Animal Disease Surveillance and Control Project

Christian Aid, London

23. Establishment of Mobile Veterinary Clinic

Ford Foundation, USA

24. Research and training in agro-forestry

Annex 4 (continued)

Oxford Forestry Institute

25. International trial on dry zone tree species

Winrock International, F/FRED

26. Multipurpose Tree Species Network Trial
27. Impact of social forestry programmes on small farmers
28. *Leucaena* seed production trial
    Co-sponsor: Nitrogen Tree Fixing Association, Hawaii

International Development Research Centre

29. Deep freezing of buffalo semen and upgrading of frozen semen technology
30. Development of improved Marke's disease vaccine
31. Selection and management of multipurpose trees
32. Development and standardisation of production for VA *Mycorrhiza Incolua*

Annex 5: **BRIAH'S PRODUCTS**

Cattle Vaccines

1. Foot and Mouth Disease Vaccine, B. Vet. C. concentrated, Quadrivalent (D, A, C, Asia 1 strains)

2. Foot and Mouth Disease Vaccine, B. Vet. C. concentrated, Monovalent (D, A, C, Asia 1 and A22)

3. Foot and Mouth Disease Vaccine, superconcentrated Quadrivalent (D,A,C, Asia 1 strains)

4. Haemorrhagic Septicaemia Vaccine (Adjuvanted with BRIAH Gel - "ALUMINOX")

5. Black Water Vaccine (Adjuvanted with BRIAH Gel - "ALUMINOX")

6. Rinderpest Vaccine (live) Freeze Dried Tissue Cultured (TCRP) B P (Vet.) with BAIF's Special diluent

7. Brucella Abortus C-19 (live) Vaccine (Now a freeze-dried product)

8. Haemorrhagic Septicaemic and Black Quarter Combined Vaccine (Adjuvanted with BRIAH Gel - "ALUMINOX")

Sheep Vaccines

9. Enterotoxaemia Vaccine *Clostridium welchii* type D (Adjuveanted with BRIAH Gel - "ALUMINOX")

10. Enterotoxaemia Vaccine *Clostridial welchii* type C and D (Adjuvanted with BRIAH Gel - "ALUMINOX")

11. Multi-Component Vaccine Pentavalent (contains *Clostridial welchii* type B, C and D, *Clostridial septicum Clostridial oedemation* (Adjuvanted with BRIAH Gel - "ALUMINOX")

Annex 5 (continued)

Poultry Vaccines

12. Marek's Disease Vaccine (living) B P (Vet.) with BAIF's Special Diluent

13. Newcastle Disease (Ranikhet Disease) Vaccine F-LaSota Strain (living) B P (Vet.) with BAIF's Special Diluent

14. Newcastle Disease (Ranikhet Disease) Vaccine (living) Mukteswar Strain with BAIF's Special Diluent

15. Fowl Pox Vaccine (living) with BAIF's Special Diluent

16. Avian Infectious bronchitis Vaccine (living) with BAIF's Special Diluent

17. Ranipox (combined R D and Fowl Pox) Vaccine

BRIAH produces a further 7 diagnostic antigens, 24 veterinary pharmaceutical, the adjuvant Aliminox" and two types of *rhizobial* culture.

Annex 6: **TRAINING PROGRAMMES AT URULIKANCHAN**
(Selected only)

	Programme	Duration (week)
1.	Dairy cattle management for farmers sponsored by Action for Food Production (AFPRO)	3
2.	Dairy cattle production for farmers (in Marathi) sponsored by Government of Maharashtra	1
3.	Orientation programme in AI and dairy cattle production for BAIF personnel	3
4.	Refreshers training programme for AI technicians for BAIF personnel	1
5.	Advance training programme in dairy cattle management for dairy farmers (in Marathi)	1
6.	Introductory course for dairy cattle management for college students	3 days
7.	Dairy cattle management for dairy owners (in Hindi)	1
8.	Training programme in community biogas system sponsored by DNES, GoI	1
9.	Training programme in biogas construction sponsored by DNES, GoI	1
10.	Dairy farm management and fodder production for BAIF personnel	12 days
11.	Linkman training course sponsored by AFPRO	1 day

Annex 6 (continued)

	Programme	Duration (week)
12.	Orientation programme for livestock inspectors in AI and animal health for Bihar Government employees sponsored by Government of Bihar	1
13.	Preventive animal health programme for BAIF personnel	1
14.	Clinical veterinary practice programme for BAIF personnel	1
15.	Training programme in community health for villagers	1

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