

6. 英国ミッションの活動概況

BRITISH TROPICAL AGRICULTURAL MISSION,

BOLIVIA 1976-1984

Santa Cruz, Bolivia

October 9, 1984

BRITISH TROPICAL AGRICULTURAL MISSION, BOLIVIA 1976-84

A team of up to ten tropical agricultural specialists worked in several areas of Bolivia in the first British Tropical Agricultural Mission from 1963 until its termination in 1972.

A second British Tropical Agricultural Mission (BTAM 2) commenced in 1976 and was seconded by the Ministry of Agriculture to work in support of the Centro de Investigación Agrícola Tropical (CIAT) that was then being formed. CIAT was to be the agricultural research and extension organization of the department of Santa Cruz. CIAT has no connection with the better known Centro Internacional de Agricultura Tropical situated in Colombia that uses the same initials.

CIAT was planned to be a dependent of the Ministry of Agriculture but over the years the financial contribution of the Ministry to CIAT has dwindled to virtually nothing as has its influence on CIAT's policy. CIAT is now funded largely by the Santa Cruz Development Corporation (CORDECRUZ) which is itself financed by taxes on petroleum and natural gas revenues. CIAT is also supported by the local agricultural producers organizations that are federated in a chamber of agriculture of some considerable political power. This has been entirely beneficial for CIAT as it has escaped the financial difficulties of the Ministry of Agriculture that have effectively paralysed its activities in recent years. There is no doubt that CIAT is the only potential counterpart organization in Bolivia that could meet the requirements of local funding needed for any worthwhile programme of BTAM 2.

The department of Santa Cruz lies between 13° and 20°S and covers 370 000 km<sup>2</sup> of which 7% is Andean foothills. The remainder is a plain with a mean altitude of 390 m that stretches from the Andes eastward to the Brazilian border.

The human population is some 700 000 (1976) of which half dwell in the city of Santa Cruz and its satellite towns. Prior to the development of the

Farm productivity is astonishingly low but is not due to any invincible technical problem. Scattered across the same area are communities of people indigenous to the area who may be landless or who have communal land rights which are occasionally challenged by the commercial sector. Successful development projects for some communities are well advanced in the south where sponsored by a church organization and near the Brazilian border where it is financed and managed by the departmental development corporation.

The objective of CIAT is the generation of appropriate technology and the transference of this knowledge to farmers or development agencies for implementation. BTAM 2's objective is to give technical support to CIAT and to assist it in the training of its own pool of Bolivian experts so that at mission termination CIAT will be able to function without foreign technical assistance. This training is provided at both inservice and formal levels, the latter being achieved by providing scholarships to study abroad.

While BTAM 2 assists CIAT in all aspects of its programmes, it prefers to concentrate its resources on methods of alleviating rural poverty in the small farm sector. It should be noted that there is considerable and increasing urban poverty that might be best alleviated through efficient production of food by the whole farming sector.

For the first six years of its operation, BTAM 2 was heavily biased towards animal production having two pasture specialists, (one of whom was Team Leader from 1976 to 1981) an animal production specialist supported by a second for three years and an animal health specialist for two. During this period the CIAT crop production programme was only supported by one cotton agronomist and specialists in weed and crop pest control.

An agricultural economist joined BTAM 2 in 1978 and in 1980 ODA decided that the mission should continue operation under a multidisciplinary farm systems research approach. Recruitment difficulties prevented the

achievement of a balanced team that was necessary for this policy until July 1984 when the team consisted of specialists in the fields of:

- agricultural economics
- annual cropping
- perennial crops
- soils
- animal production
- pastures

Another member of BTAM 2 has worked since 1980 with the sugar cane research institute CIMCA in the field of integrated pest management of that crop.

During its eight years of existence BTAM 2 has substantially assisted CIAT in the generation of appropriate technology and the enclosed notes indicate in layman's terms the more important achievements of the team to date. Much of the work is well known internationally and is widely cited. In spite of BTAM's extensive training programme (both formal and in-service) the objective of building up a cadre of well trained counterparts in CIAT, has been less successful. As in many other developing countries, the returning well qualified MSc graduate is easily able to obtain a post that is much senior to that for which his training was originally intended. His acceptance of such a post is certainly a loss to CIAT and to BTAM 2's programme but since he continues elsewhere in the agricultural sector, organisations such as the Central Bank, the regional development corporation and the University benefit and H.M.G.'s investment is far from wasted. CIAT has now instituted more rigid contracts with high penalty clauses in order to minimise any future staff losses.

BTAM 2 has also assisted the University of Santa Cruz by giving some twenty, six month scholarships to finance theses investigations of students whose study is related to the work of CIAT and the Mission.

BTAM 2 has also cooperated with ODA's own training programme and since 1978 has had at any given time, up to four Postgraduate Training Award Scheme Students as part of its team, each on attachments of 12-13 months.

*J.V. Wilkins*

TEAM LEADER

4th October, 1984

THE PASTURE DEVELOPMENT PROGRAMME ACCOMPLISHMENTS 1976 - 1984

The Santa Cruz Department has an area of 370.621 square kilometers, and comprises a third of the territory of the Republic of Bolivia. It can be broadly divided into 6 agro-ecological zones, ranging from the Mesothermic Valleys with up to 2.000 m altitude to the tropical forest area of Yapacaní at some 300 m altitude, from the dry Chaco area in the South, to the seasonally flooded natural pastures in the North and extreme East along the borders with the Beni Department of Bolivia, and with Brazil, and with soils which range from relatively new, fertile alluvial formations in the Central area to the old, acid, infertile soils of the Brazilian (Precambian) Shield in the East.

RECOMMENDATIONS

The areas that have received most attentions are those of the Central zone, Yapacaní and the Brazilian Shield, where firm recommendations for both grass and legume species are available. Recommended pastures will carry 2 - 4 times more animals than either native pastures, or the species of pastures sown prior to 1976, and will produce up to 40% more milk per cow. Steers grazing the improved pastures reach slaughter weight at 28-32 months of age, compared with 4-5 years under the traditional grazing management.

Heavy emphasis has been placed on the incorporation of legumes into the grazing system, and recommendations are available for:

1. permanent pastures of legumes associated with grasses.
2. permanent legume reserves to complement existing pastures.
3. annual summer (wet season) legumes
4. annual winter (dry season) legumes
5. methods of establishment of legumes into existing pastures

Acceptance of CIAT/BIAM results and recommendations has been good in these areas, as evidenced by the lively demand for seed of improved species (see below). Species recommendations are available for sown pastures in both the valleys and the Chaco zones, although in these areas, farmer acceptance has been slow, since the economic climate does not presently favour bush-clearing and pasture sowing in these drier areas. A programme was established to study native browse in the Chaco in order to recommend improved resource management. Preliminary results are available, but work should continue in this area. A programme of work on the slopes above the Valleys has been planned, and should start in 1984-85.

A study was started to evaluate pastures for seasonally flooded conditions (up to 3 months under water). Preliminary results indicate that natural pastures are of better quality than cultivated grasses, but yields are much lower, particularly in the dry season. In these conditions, small areas of sown species could usefully compliment the natural grazing areas.

#### SEED AVAILABILITY

The CIAT/BIAM pasture programme has worked closely with the seed production organization SEFO SAM, which was set up, and continues to be supported by the Swiss TC organization, COTESU. Before 1976, the only seed available was sufficient to sow 3-500 ha per year of a grass of medium quality (Hyparrhenia rufa). For the 1984-85 season, locally produced seed will sow 4.000 ha of Brachiaria, a high yielding grass, together with some 1.000 of grass-legume associations and a further 1.000 ha of pure legumes.

The interest to expand sowings of new, improved pastures has been created largely by the extension and demonstration activities of the programme. Demand for seed exceeds supply in Brachiaria, and annual importation is currently running at levels sufficient to sow a further 1500-2000 ha of this important grass.

#### TRAINING

A total of 11 local graduates from the University have realized their first-degree thesis studies under the direct supervision of the Pastures Programme, and of these, 7 have been financially supported by BTAM studentships. Many other students, have been assisted in some aspects of the preparation of their thesis studies.

Three counterparts have been sent to study to MSc level overseas, as part of the formal training activities of the programme, one in the University of Queensland (Australian Government Scholarship) one in CATIE, Costa Rica (British Scholarship) while the third is currently in Vicosa University, Brazil (British Scholarship).

In service training has been provided to several counterpart officers.

#### OTHER ACTIVITIES

Support and advice has been provided to other Santa Cruz organizations such as CORDECRUZ, PFGASACRUZ and the University in all programmes that have contained a pastures component.

Sources of vegetative material have been established in several isolated areas.

Occasional visits have been made to the Chapare (Cochabamba Dept.), to Riberalta (Beni) and Cobija (Pando) and to Boyuibe and Muyupampa (Chuquisaca) at the invitation of other organizations to provide advice on on-going programmes.

Results have been published at all levels - institutional reports, national and international meetings and journals. Many field days and farmer meetings have been attended, and excellent relations established with the cattle producers.



## THE FUTURE

The Pasture Research and Development capacity of CIAT has been established. It is able to function alone, without further TC input, provided that the present staff is not lost, or promoted into administrative positions. It is anticipated that over the next 3 years, about 60% of the activities of the section will be devoted to Extension and Development, since there exists a body of information that needs to be applied in the farming community. In the absence of a strongly developed extension organization, this must be done by the specialist section.

A programme of investigation that can be carried out by the present staff has been planned for 1984-85. One programme member is currently undergoing post - graduate training in Brazil. He is expected to return to Bolivia in the first half of 1985. It is recommended that a further staff member (Ing. Gerardo Vega) should receive overseas post-graduate training starting in 1986-87.

LIVESTOCK PROGRAMME 1976-86

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At programme commencement in April 1975, parastatal organizations were planning the massive importation of Holstein cattle to replace the low yielding zebu/criollo cattle of the area. The importation plans were justified by the result of a survey in which farmers already owning Holstein cattle were asked how much their cows yielded and what was the fertility and calf mortality in their herds. The results suggested satisfactory performance but CIAT/BTAM doubted this as no records were kept anywhere and the answers obtained were the estimations of the owners which appeared to CIAT/BTAM to be excessively optimistic. A recording programme on 24 farms was conducted over a two year period producing results which have been widely cited outside Bolivia. The most important results were:

a) that the importation of females of European dairy breeds for milk production was inadvisable because of health problems in the tropical environment. This caused the cancellation of further importations by the parastatal organizations with the consequent saving from great loss of the farmers who would have received the cattle.

b) that if Holstein or Brown Swiss bulls were used on zebu criollo cows, the half bred progeny were superior to pure Holsteins and Brown Swiss and much superior to zebu/criollos, and if the half bred progeny were again mated with Holstein or Brown Swiss bulls, the three quarter bred progeny had a performance very similar to the half breeds. However if the three quarter bred Holsteins Brown Swiss were mated with a Holstein or Brown Swiss bull the resulting progeny had high calf mortality and low fertility and were similar to the pure breeds.

It was therefore apparent that the most suitable dairy cows for the zone were those that had not more than 75% blood of the European dairy breeds. It was now possible to recommend to farmers who owned zebu/criollo cows

and who wished to commence dairying that they should buy a good quality Holstein or Brown Swiss bull and mate their cows to produce half bred of good productivity but tolerant of high temperature and humidity and resistant to parasites and disease. These half bred could be mated with Holstein or Brown Swiss bulls but their progeny should be mated with a tropical dairy breed such as the Criollo to restore vigour and tolerance of the tropical environment.

There are no cattle that are native to the Americas but the Criollo is descended from animals imported from Spain in colonial times and has had over four centuries in which to become adapted to the area through natural selection. It normally produces relatively little milk or meat but is healthy, fertile and very docile. Bolivia possesses one of the largest populations of this breed but it is declining in numbers due to indiscriminate crossbreeding and a need was seen to conserve the breed, improve it by systematic selection and maintain a genetic pool whose quality was constantly improving. Bulls would be produced from this pure pool for use in systematic crossbreeding programmes with the Holstein and Brown Swiss.

A pilot scheme was commenced in 1978 to test the genetic potential of the Criollo under controlled conditions and was made possible by a grant of £ 50,000 from the British Government. A herd of 50 cows was bought and semen of Criollo bulls purchased and imported. The funds were also used for buildings, fencing and land drainage. By September 1984 this herd had multiplied to 213 head of which 102 were adult females.

Concurrently with this programme, an investigation began in which the relative merits of mating a herd of Brown Swiss cows with either semen from Brown Swiss bulls in the United States or semen of improved Criollo bulls. The results of these parallel programmes serve as the justification for the increasing of the pilot stage of the project into its final phase in which it is planned that there will be a herd of 300 adult females producing over 90 bulls for sale per year and in which 10 bulls will be progeny tested annually.

It is now established that selected, improved Criollos have lower calf mortality, grow faster, are more fertile and give 50% more milk than the unimproved. They are also suitable for beef production. It is also known that the mating of pure Brown Swiss cows to Criollos rather than Brown Swiss bulls leads to lower calf mortality, faster growth rate, earlier calving and more milk produced per year due to higher fertility.

While it is now established that a man with zebú/criollo cows can economically and practically commence dairying through crossbreeding, it has been shown that it is not economically feasible for the non cattle owner to borrow capital to purchase cows for this purpose and development pathways are being investigated to determine the most suitable for the small farmer.

It was hypothesised that two sows may generate profits to buy a few sheep and establish pasture. Pasture would be gradually extended in accordance with the needs of the increasing flock that might ultimately be exchanged for cows. This is being investigated and it has been determined that

a) sows can be kept profitably at low cost if they are protected against parasites and disease.

b) sheep can be kept profitably on an extensive system if protected against parasites.

Economic and feasible methods of increasing piglet speed of growth are being investigated using readily available foods.

The performance of sheep maintained intensively on pasture and their potential health problems are being investigated.

The control of movement of pigs and sheep is difficult or costly and will require research.

Animal traction is becoming increasingly attractive economically for the small farmer and three organizations are encouraging the use of light horses for this purpose. As oxen are probably hardier, certainly stronger and have a much higher end-of-working-life resale value, they may be superior for this purpose. They can also be produced as a byproduct from the cow herd. The problems of training oxen and their relative work performance are being investigated. Criollos are being used thus making them potentially triple purpose - milk, beef, work.

The CIAT/BTAM livestock team determined that the notoriously low productivity and profitability of Bolivian cattle ranches was due to very low numbers of calves being produced per year and that this low productivity could be greatly increased by the implementation of well established management measures. This would result in increased profitability.

A programme was initiated to demonstrate this and in each ranching area a cooperating property is selected that is typical of the area. A study is made of the property and management changes implemented. Improvements in profitability are used to encourage others to imitate the improvements in management expertise.

ANNUAL HEALTH PROGRAMME 1977-80

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The animal health programme ran from October 1977 to April 1980. In that period seven diseases were investigated on milk producing farms in the zone.

1. Tick Borne Diseases

These were shown to be endemic.

2. Brucellosis

Is widespread but of low prevalence. It is a potential danger for intensive livestock production.

3. Leptospirosis

Is endemic and may contribute to low fertility in cattle.

4. Tuberculosis

Was found only in those herds into which cattle had been imported. This was an important finding suggesting the feasibility of eradication by testing and slaughter before further spread. A TB testing programme was initiated by the milk producers association and continues.

SALMONELLOSIS

Exists in cattle in the area and may also endanger humans.

MASTITIS

Is common but is less frequent in those herds where the cows suckle their

calves. This important finding gave further justification for this practise that produces healthier calves.

The practise has been adopted at the Saavedra Experimental Station and is demonstrated to visitors.

#### HAEMONCHOSIS

*Haemonchus* spp is the predominant internal parasite of calves in the area.

WEED CONTROL PROGRAMME 1977-83

British Technical Co-operation with the CIAT Weed Management Programme began in January 1977 and ended in September 1983. During this period emphasis was placed on the development of recommendations for the chemical control of weeds in a range of annual crops, including rice, maize, cotton, soybean, wheat, peanut and sunflower. This task has now been completed and recommendations exist for the control of all the major weeds in most crop situations in the Department of Santa Cruz. Worthy of note are the recommendations for the control of Rottboellia exaltata in a range of crops, particularly in mechanised rice, and the control of Imperata spp. in small farmer slash and burn agriculture. The programme was not however restricted to annual crops, an investigation into chemical weed control in pastures was also completed in collaboration with the CIAT/Misión Británica pastures team.

Once proven, CIAT/Misión Británica recommendations were published as a range of small extension bulletins, which have been distributed to extension workers, not only to those of CIAT but to those of other government institutions, producer organizations and to the many voluntary agencies working in Santa Cruz.

The Weeds Programme has also been involved in the organization of demonstration trials operated in collaboration with CIAT extensionists. This aspect of the programme is on-going; the need to extend recommendations of already proven technology, by whatever means possible, will remain an important feature of the Weeds Unit's Programme.

During the period of British cooperation a firm base was laid for the continuance of the Weeds Programme when British support ended. This included training, both of direct counterparts and others, the development of a reference library and of scientific contacts within the discipline of weed science, the establishment of a weed herbarium, now one of the most complete in Santa Cruz, and through the provision of associated equipment



including sprayers, nozzles and climatic measuring apparatus.

Counterpart training has always been an important part of the British Mission's role. During the almost 7 year period of support to the Weeds Programme, five Bolivian counterparts benefited from having contact with the T.C.O. in post. Of these, one went onto Ph.D. studies in Germany and later to a lecturing post at the local University, two benefited from British government scholarships to successfully obtain Masters degrees and one other went on to work in the private sector for the producer-funded oilseeds co-operative.

Of the two Bolivians who benefited from British funded M.Sc. training, one became Head of Research in CIAT and is now Head of the Santa Cruz University Research Station, the other, who returned to Bolivia from overseas training in May 1984, is now Head of the Weeds Unit.

Training however was not restricted to direct counterparts: four University thesis studies have been completed under the supervision of the Weeds Programme, and lecturing courses were given at both University and agricultural college level.

The Weeds Programme is continuing and with the deteriorating economic situation in Bolivia raising the relative cost of chemical weed control, the programme is now looking towards a more integrated weed management approach - such as the use of legume cover crops as weed control agents. This will benefit in particular smaller producers who cannot afford or do not have access to imported agro-chemicals.

Martin Froment,  
Cropping Systems Agronomist  
September 1984.

COTTON PROGRAMME 1977-81

BTAM involvement with cotton started with BTAM 1 and has continued with input from weed and crop protection specialists. The cotton programme as such ran from 1977 to the end of the 1980/81 season.

1. Variety Screening

The cotton industry was dependent on imported seed from the USA. In an attempt to overcome this variety screening trials were conducted at Vallecito (UBCRM), on farmers' lands and with less success at Saavedra Experimental Station. Nearly 200 varieties were screened. These were mainly North American varieties but also included material from Paraguay and Africa.

Despite unusually heavy and badly timed rain the variety REBA B50 was selected to replace the American STONEVILLE varieties currently in use. Unfortunately REBA B50 was found to be highly susceptible to Ramulosis (Colletotrichum gossypii var. cephalaspoides) which reached Santa Cruz from Brazil in 1980, the last season of the programme. Today the industry remains mainly dependent on the Stoneville varieties which are less susceptible.

2. Seed Multiplication

It was initially the opinion of the cotton industry that good quality seed could not be grown, treated and stored economically in Santa Cruz. Initial results demonstrated that this view was false and a joint seed multiplication scheme was set up with collaboration between CIAT (screening and foundation seed maintenance), CORCEPAI (1) (early multiplication) and ADEPA/MACA (final multiplication).

REBA B50 was chosen for multiplication and initial success was encouraging. In the first year sufficient seed was produced for some 20% of the farmers

but in later years the poor weather conditions caused heavy losses. The scheme was thrown into disarray by the ramulosis outbreak of 1980.

In retrospect it seems doubtful that the policy of adopting only one variety was wise and it perhaps might have been better to have set up a single organisation rather than the joint scheme.

### 3. Agronomy

An agronomy research programme was initiated at Saavedra. Crop timing and spacing were investigated with emphasis on REBA B50. However Saavedra was found to be unsuitable for cotton so in the following season the emphasis shifted to rationalising the considerable body of empirical knowledge held by the producers. As a result a series of recommendations were produced.

### 4. Soil Fertility

A survey of cotton fields was carried out and nutrient deficiencies noted.

### 5. Crop Protection

Crop protection work was undertaken in collaboration with other RTAM specialists. The variety selection programme demonstrated the resistance of REBA B50 to Fusarium but its susceptibility to Ramulosis. The insect pest complex proved easy to control and ULV sprayers were successfully introduced. Interesting collaborative studies were carried out with Trichogramma in San Julian.

### 6. Small Farmer Cotton Scheme

Cotton was a new crop to the colonist farmers of San Julian but it was felt that the crop had potential in the zone. A production package was drawn up and a pilot project conducted in the two seasons 1978-1980. The results of the pilot project highlighted the practical difficulties

of work in San Julian, in particular the poor communications both with the rest of the department across the Rio Grande and within the colonisation area. Nevertheless, the project suggested that cotton could be produced economically on a small scale in Santa Cruz but that the production system included conflicting labour demands with other crops.

Following the pilot project CORDECRUZ, ADEPA and CIAT initiated a small farmer cotton scheme in San Julian and Cotoca in the season 1980-81. This scheme is still in operation and has recently been examined by the Agricultural Economics Unit.

CROP PROTECTION 1976-83

BTAM involvement with CIAT in crop protection concentrated in the years 1976-82 on cotton because problems were obviously serious in that crop, the pests of sugar cane were being investigated by CIMCA and those of the grains and soya by an American supported programme. The following were the more important achievements.

1. Insecticide Recommendations for Cotton

Three years of trials permitted firm insecticide recommendations for major cotton pests.

2. Control of Bolivian Cotton Weevil

Investigation led to integrated control recommendations for this pest.

3. Ultra Low Volume Spraying

The technical advantages of this practise from ground and air were demonstrated.

4. Control of Pink Bollworm Using Pheromones

The validity of using pheromone traps for monitoring was investigated.

5. Pink Bollworm Diapause

The importance of this larval phase in surviving the Santa Cruz winter was demonstrated.

6. The Control of Cotton Pests by Parasite Release

The use of Trichogramma in the control of some cotton pests was unsuccessful but very clearly demonstrated the physical and management problems of this practise that caused the failure.

CONTROL OF PESTS IN TOMATOES

Excessive use of organic phosphates to control leaf miner was reduced by demonstrating the value of spraying with pyrethroids.

SMALL FARMER GRAIN STORAGE

Loss and contamination of stored grain was described that subsequently led to a FAO grain storage programme.

Other work of importance was university lecturing, general pest surveys of rice and soya, the identification of the cause of a pineapple rot and the nematode and plant disease surveys carried out by ODA consultants.

The programme terminated in September 1983.

AGRICULTURAL ECONOMICS 1978-84

Prior to the formation of the CIAT Agricultural Economics Unit (AEU) in 1978 there had been no systematic economics input into the agricultural research effort in Santa Cruz. BTAM was instrumental in establishing the AEU.

The AEU has played a leading role in the development of an appropriate Farming Systems Research (FSR) approach in CIAT based on international experience with other FSR programmes. This provided the framework for carrying out the classification of farm types and the diagnosis of farm systems; a number of procedures involving different survey and analysis techniques have been introduced.

Several diagnostic studies have been carried out including an agro-economic formal survey in the Northern Colonisation Area which provided a classification of farm types, a data base on agriculture in the area and an analysis of problems and opportunities in the zone. Following this a case study of the five principal farm types in the area was carried out providing data on labour use and cash flow over the agricultural year. The data base thereby established provided a basis for subsequent planning of research trials and the interpretation of the results. Theoretical farm models were also drawn up to study the likely farm development strategies adopting a number of different paths.

Multi-disciplinary teams consisting of agricultural scientists from various programmes within CIAT/BTAM have been formed with the AEU to carry out informal surveys ('sondeos') in areas where new research plans are being drawn up (Valles Mesotérmicos, La Guardia-Angostura, Mairana and Cordillera Province). These 'sondeos' have provided a useful vehicle for involving interchange between disciplines at the earliest stages of the research process from the identification of issues for research, the priorities and

the research trials themselves. Apart from producing research planning documents these 'sondeos' have proved to be useful exercises in training counterpart staff in some of the concepts and procedures of the FSR approach.

The economic analysis of the results of research trials has been instituted to assist in the interpretation of results and to advise on the economic viability of results and their formulation into farm recommendations.

These activities have constituted the main thrust of the role the AEU has in its support function for the technical programmes of CIAT, helping to promote the development of a research programme that is appropriate to the needs and resources of the area, and farmer recommendations that are both appropriate and viable.

Other work has involved economic studies of special issues and projects both within CIAT and within other institutions such as CORDECRUZ.

The results of the work has been published and widely distributed within Bolivia and also to certain international agricultural research centres and universities. Some have been published internationally in journals.

#### TRAINING

Since agricultural economics is included in the Santa Cruz University's course on agriculture as a minor subject the British Mission has played a key role in both the establishing and running of the Agricultural Economics Programme and in training. Four Bolivians have been sent to study to MSc level as part of the formal training activities. Two of these went to Britain on British Council Scholarships; both of these studied at Reading University (Diploma) and subsequently one at Wye College and the other at Leeds University for the MSc.

Four local graduates from the University have successfully completed their first degree thesis studies under the direct supervision of the Agricultural



Economic Programme. Three others remain to be completed. All seven have been financially supported by BTM studentships. Several other students have been assisted in certain aspects of their thesis studies.

In service training has been a major activity in the form of training counterpart staff and the formation and managing of multidisciplinary teams operating under the FSR approach has helped to broaden the understanding of and familiarity with the FSR approach itself.

William Lawrence-Jones

October 2nd, 1984

CROPPING SYSTEMS PROGRAMME 1983-84

The Cropping Systems Unit was formed in September 1983 with the principle aim of examining the agronomic problems of small colonist farmers practising slash and burn agriculture. The stabilisation of slash and burn farming systems is seen as a key to rural development in the Northern Colonization area of Santa Cruz.

As a first step towards this objective, the Cropping Systems and Economic Units of CIAT/Misión Británica reviewed the experimental work carried out in the Northern Colonies area and drew up a list of research recommendations aimed at solving some of the important agronomic problems faced by this farm group. Experimental trials are planned for the coming year to answer some of the questions proposed in this report.

The CIAT/Misión Británica team has also been involved in multidisciplinary studies in other areas. These short studies aim to identify key agronomic and related development problems and on the basis of this information to orientate the investigational programmes of CIAT/Misión Británica. An example of this was a study in an area S.W. of Santa Cruz, which identified key areas for investigation and extension by CIAT. One of these topics was broom sorghum, a crop identified as being solely in the hands of small farmers and an important generator of a small scale rural industry involved in broom manufacture. In the forthcoming season CIAT will carry out a small trials programme to examine some of the specific problems associated with this crop.

Training has always been an important part of the British Mission's work, the Bolivian counterpart in the Cropping Systems Unit will shortly be presenting a thesis study on work carried out during the last year and another student is benefiting from a British Mission Scholarship to carry out research to be presented as a Thesis Study.

M.A. Froment

October 3rd, 1984

TREE CROPS PROGRAMME 1984

BTAM I had considerable involvement with the development of tropical tree crops in Bolivia. In particular assistance was given to the COFFEE and COCOA growers of the department of La Paz through the introduction of improved varieties, cultural practices and processing. There was limited involvement in BANANAS, mainly through the introduction of varieties from the variety collection of the University of the West Indies, Trinidad.

BTAM II at first did not have any tree crops involvement per se but study of the problems of small farmers through the methodology of Farm Systems Research (FSR) suggested that farmers with healthy tree crops on their farms were better equipped to survive the "Barbecho Crisis". (In which swidden farmers have come to the end of their unused high forest and, faced with declining yields, must either find new technology and more capital or move on).

CIAT, therefore, decided to set up a Perennial Crops section and ODA agreed to recruit a Tree Crops agronomist to support it. As a temporary measure the cotton agronomist transferred to tree crops following his withdrawal from the cotton programme in 1981 and started CACAO variety and planting method trials. The Tree Crops agronomist arrived in post in February 1984 and following an initial period of familiarisation experimental work began in the 1984-85 season.

1. Suitability of the Area for Tree Crops

Tropical tree crops are quite exacting in their soil and climatic requirements. The climate of Santa Cruz includes a marked winter period of low temperatures and rainfall. An early priority of the programme is to study the suitability of a range of tree crops for the region. As Santa Cruz is poorly placed to compete in the international marketplace because of poor transport and corresponding high costs the market for

these crops is precarious and dependence on a small number of crops should be avoided. Introduction of new crops is seen as an important part of the programme.

## 2. Bananas

Two classes of banana are grown; sweet, table bananas are of limited importance. Cooking bananas or plantains are very popular in the city and command a good price. There is, however, no indication of any interest in good quality bananas of either type.

Work projected for 1984-5 includes experiments to introduce improved banana production packages developed in other countries and assess their relevance to Santa Cruz. Work will also take place to improve management of old banana fields used as shade crops for cocoa or coffee.

## 3. Cocoa

It appears that only certain areas of the Department will be ecoclimatologically suited to cocoa. However, the crop is grown in the provinces of Ichilo and Porongo and sufficient slack exists in the national market for the crop to be an attractive prospect. The most serious problem facing the crop is Witches Broom disease.

Work projected includes study of the effects of improving management of cocoa established under different shade conditions in the Chané-Hardeman area, studies of the effects of improved field management on witches broom incidence in Ichilo and establishment of variety gardens in Ichilo to complement those established in Chané-Hardeman.

## 4. Coffee

Coffee has been a traditional crop in Porongo and recently PLADERVE has successfully encouraged its production by small farmers in San Ignacio

de Velasco. It is thought that there may also be potential in the Western end of the Colonisation zone near Yapacani and along the slopes of the Andean foothills in general. The principal problems are bad management and Coffee Rust. Leaf miners are a problem in San Ignacio but may be controlled with insecticides.

Work projected includes introduction of rust resistant varieties from La Paz and establishment studies using intercropping in Forongo. The PLADERVE programme at San Ignacio has also requested help with experiments to examine for use of fertilizer to reduce overbearing dieback.

#### 5. Crop Diversification

As mentioned in (1) above crop diversification is seen as important to the region. To this end a UBGRM student has been funded to carry out a survey of the dicplant, ANATTO, which is widespread in the department and which is used in the food industry in preference to artificial colourants. Further work in this section will include the establishment of a variety nursery with material from Bolivia, Costa Rica and other countries.

Work is also planned with the Peach Palm known locally as Pejibaye. This plant has had a long history of use as a food plant in Amazonia and has recently been identified by the US Academy of Sciences as having wider potential. It can produce edible seeds or palm hearts depending on management. An export market for palm heart is thought to exist in Brazil and Argentina and there is already a local market built on another species of palm. A cannery is in operation in Santa Cruz. The peach palm has the huge advantage over other palms that it will regrow following harvest of the heart. It is thought that the crop would be most suited to the wetter areas near Yapacani. Initially work will be limited to the establishment of a variety collection.

Other work on crop diversification will include monitoring the performance of plants in the variety introduction garden at San Julian.

SOILS SECTION 1979-82

The first British Tropical Agricultural Mission had a considerable soils input and financed and initiated the existing soils laboratory in Santa Cruz and assisted in staff training.

In BTAM II a soils specialist was employed from 1979 until 1982 but due to a lack of counterpart staff, success was limited:

The soils and bromatology laboratories were reorganized and a greenhouse and extra store built.

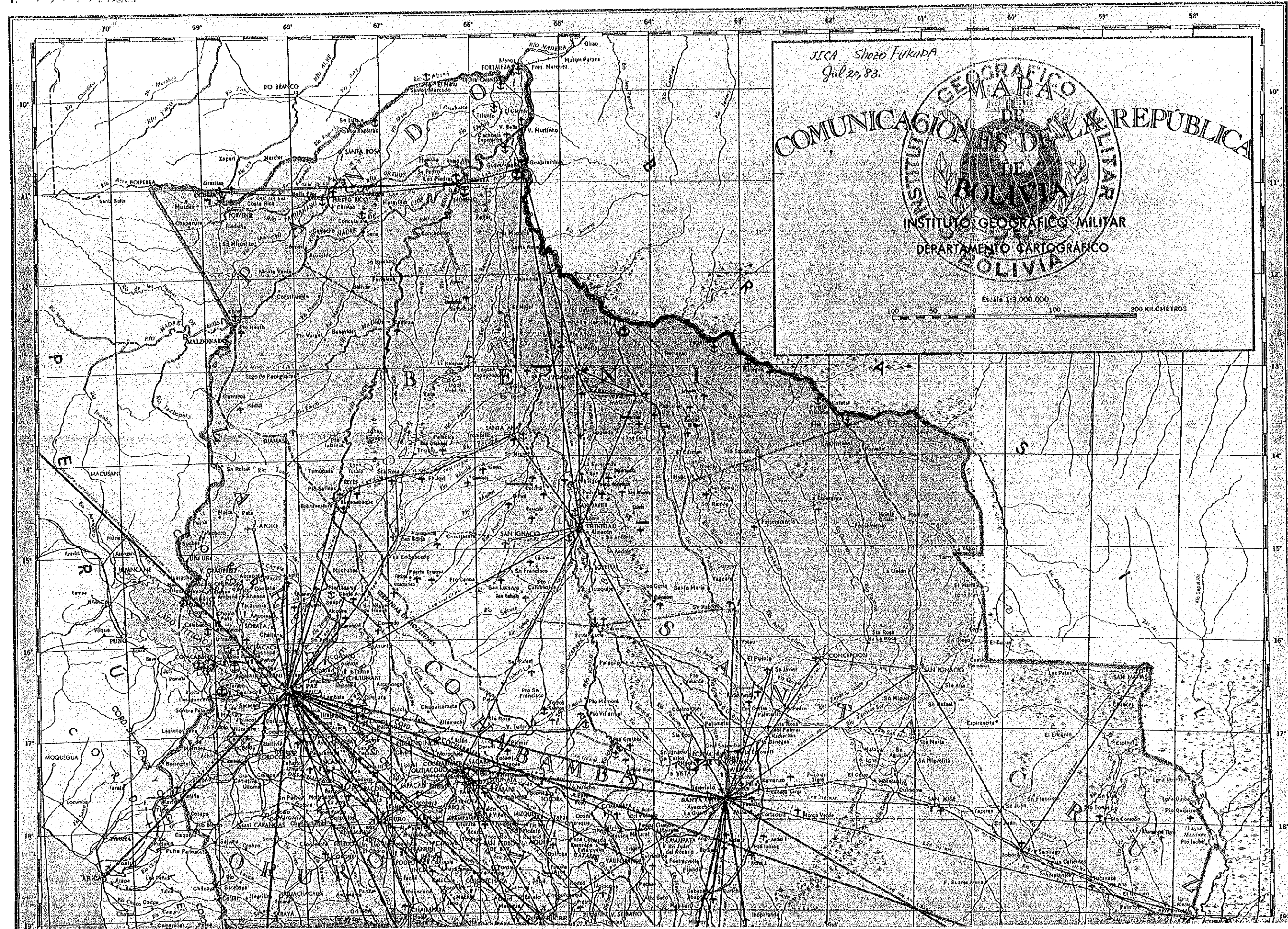
Efficiency of analysis of soil, water, plants and forages was improved.

The thesis programmes of three University of Santa Cruz students were supervised.

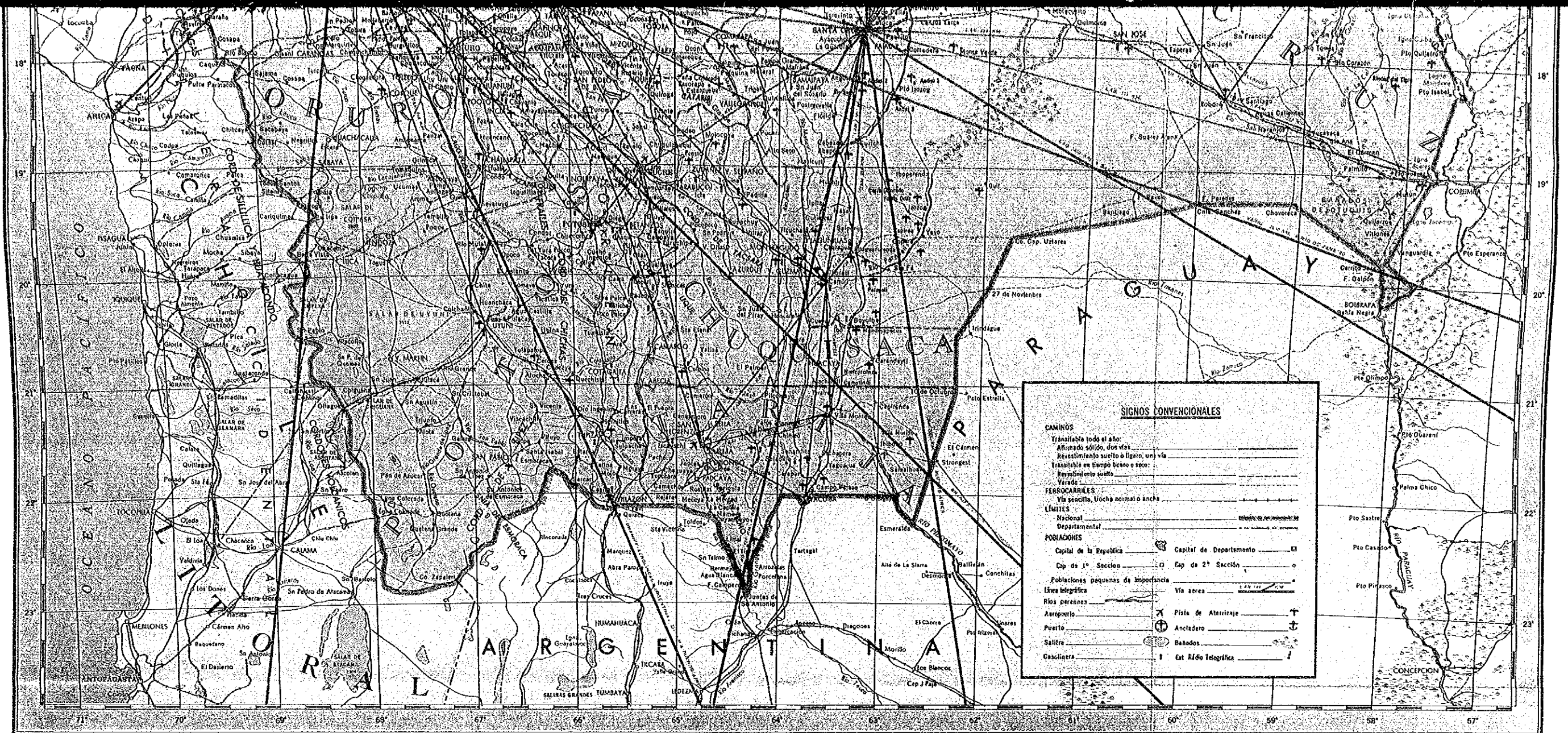
A preliminary survey of effects of mechanization on soil physical properties was conducted.

In July 1984 another soils expert arrived in Bolivia to work with a recently appointed CIAT counterpart. At time of writing their work programme is being finalized.

7. ボリビア国地図







DISTANCIAS EN KILOMETROS ENTRE LAS POBLACIONES MAS IMPORTANTES

IMPRESO POR EL INSTITUTO GEOGRAFICO MILITAR L. P. II-80

ALFABETICO	INDICE	ALFABETICO	INDICE	ALFABETICO	INDICE	ALFABETICO	INDICE	ALFABETICO	INDICE	ALFABETICO	INDICE	ALFABETICO	INDICE	ALFABETICO	INDICE
AGUAZUL	1241	AGUAZUL	1241	AGUAZUL	1241	AGUAZUL	1241	AGUAZUL	1241	AGUAZUL	1241	AGUAZUL	1241	AGUAZUL	1241

PRINCIPALES RIOS NAVEGABLES

RIO	LONGITUD	ANCHO	VELOCIDAD	OTROS DATOS
Uruguay	500	150	10	...
Uruguay	500	150	10	...

REFERENCIAS DEL CUADRO DE DISTANCIAS

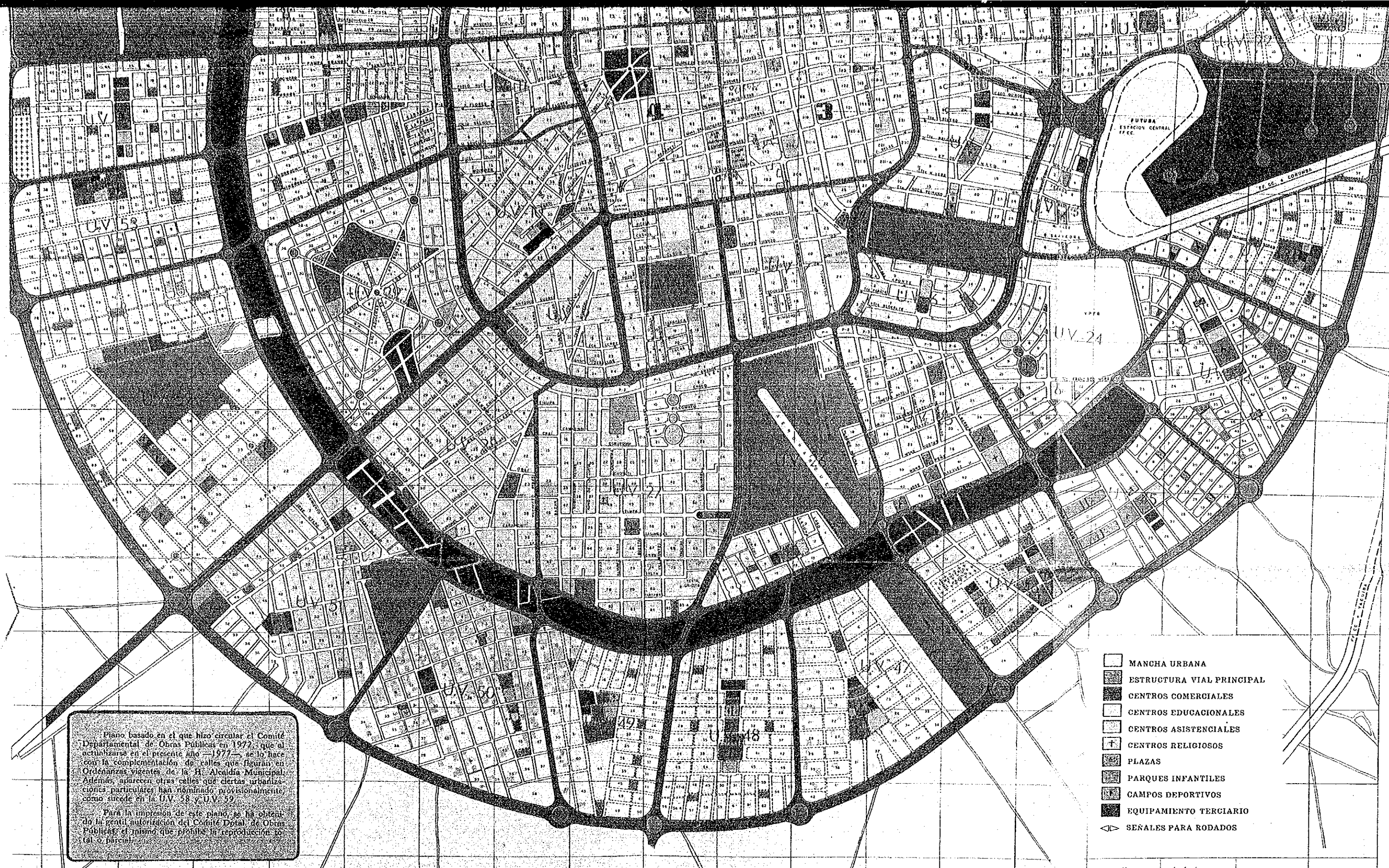
CLAVE	INDICACION	CLAVE	INDICACION
1	AGUAZUL	11	AGUAZUL
2	AGUAZUL	12	AGUAZUL

SE SOLICITA DE LOS LECTORES QUE ENCUENTREN ERRORES O OMISIONES EN ESTE MAPA, MARCAR LAS CORRECCIONES EN EL MISMO Y ENVIARLAS AL COMANDANTE DEL INSTITUTO GEOGRAFICO MILITAR, LA PLAZA BOLIVIA. ESTOS MAPAS SERAN REIMPRESOS O SUSSTITUIDOS, SI ASÍ SE DESEA. PROPINA LA REPRODUCCION PARCIAL O TOTAL DE ACUERDO A LEY.









Piano basado en el que hizo circular el Comité Departamental de Obras Públicas en 1972, que al actualizarse en el presente año —1977—, se lo hace con la complementación de calles que figuran en Ordenanzas vigentes de la H. Alcaldía Municipal. Además, aparecen otras calles que ciertas urbanizaciones particulares han nominado provisionalmente como sucede en la U.V. 58 y U.V. 59.

Para la impresión de este plano se ha obtenido la gentil autorización del Comité Deptal. de Obras Públicas, el mismo que prohíbe la reproducción total o parcial.

- MANCHA URBANA
- ESTRUCTURA VIAL PRINCIPAL
- CENTROS COMERCIALES
- CENTROS EDUCACIONALES
- CENTROS ASISTENCIALES
- ⊕ CENTROS RELIGIOSOS
- PLAZAS
- PARQUES INFANTILES
- CAMPOS DEPORTIVOS
- EQUIPAMIENTO TERCIARIO
- ◁ SEÑALES PARA RODADOS

**COMITE DEPARTAMENTAL DE OBRAS PUBLICAS**  
**OFICINA TECNICA DEL CONSEJO DEL PLAN REGULADOR**



*Jullian Escobar, Dpto. Plan. - La Paz - Bolivia*







JICA