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EXPERIENCES IN COLLABORATION

Ginger Pests and Diseases

INDO-SWISS PROJECT SIKKIM

inter cooperation
Natural Resource Management
Rural Economy
Local Governance and Civil Society

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ACIAR	Australian Centre for International Agricultural Research
ARD	Adaptive Research Demonstrations
CABI	Centre for Agriculture and Bioscience, International
CIPMC	Central Integrated Pest Management Centre
CBO	Community-based organisations
CSS	Centrally Sponsored Scheme
DAP	Di-ammonium phosphate
DD (E&T)	Deputy Director Extension and Training
DD (R&D)	Deputy Director Research and Development
DOH	Department of Horticulture
DPI	Department of Primary Industry
DWCRA	Development of Women and Children in Rural Areas
FYM	Farm-yard manure
GDTF	Ginger Disease Task Force
GOI	Government of India
GOS	Government of Sikkim
HF	High frequency
HI	Horticulture Inspector
HO	Horticultural Officer
ICAR	Indian Council of Agriculture Research
IISR	Indian Institute of Spices Research
IPM	Integrated Pest Management
IRDP	Integrated Rural Development Program
ISPS	Indo-Swiss Project Sikkim
KVK	Krishi Vigyan Kendra
NAARM	National Academy of Agricultural Research Management
NCUI	National Co-operative Union of India
NGO	Non-government organisation
PC	Project Coordinator
PO	Project Officer
PRA	Participatory Rural Appraisal
PTD	Participatory Technology Development
RDD	Rural Development Department
SDHO	Sub-divisional Horticulture Officer
SIRD	State Institute of Rural Development
SGSY	Swarnjayanti Gram Swarozgar Yojana
SWOT	Strengths, Weaknesses, Opportunities and Threats
TERI	Tata Energy Research Institute
TRYSEM	Training of Youth for Self-Employment
UK	United Kingdom
VLW	Village Level Workers
YPO	Yearly Plan of Operation

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Preface

Ginger is an important crop in Sikkim. Big and small farmers cultivate it, and, for many, it is their only source of income. We have known for a long time that pests and diseases severely hamper production and limit yields. If they were controlled, the livelihoods of many farmers, the least privileged, in particular, would be helped greatly.

The Indo-Swiss Project Sikkim is the first bilateral project in the State. It started in 1993, to improve the wellbeing of farmers. Under a research and development component for ginger, carried out in collaboration with the Department of Horticulture, there is now a clearer understanding of the pests and diseases, and how they might be managed better.

The lessons to be learned from the project's interventions are documented in this report, entitled *Experiences in Collaboration*. It will be a useful source of information. The experiences gained will provide valuable insights for the Government of Sikkim, the Department of Horticulture, the Swiss Agency for Development and Cooperation, Intercooperation, ISPS and NGOs/CBOs, when planning and implementing similar projects in the future.

I compliment the Indo-Swiss Project Sikkim for the work that has been done for the farmers of Sikkim. I would also like to record my appreciation for the assistance provided by Dr Grahame Jackson in bringing out this report.

S W Tenzing, IAS
Chief Secretary
Government of Sikkim

Gangtok, 27 July 2004

Foreword

You may well wonder how the control of *Pythium* or a nematode affecting ginger in the state of Sikkim, is relevant for a development practitioner anywhere else?

The answer to why ginger is so important for farmers in Sikkim is easily found – it is the only significant cash crop and provides farmers the money for agricultural inputs, to repay debts and pay their medical and other bills. Most of the farmers in the state have small holdings, ginger is cultivated on un-irrigated lands or as an intermediate crop in paddy fields.

Pests account for crop losses that are variously estimated to be between 10 to 50 percent. While large farmers are able to retain healthy seed stock from their own cultivation, small and marginal farmers generally sell their whole harvest and buy or receive diseased seed stock. With their small holdings, they have little opportunity for crop rotation and the cycle of disease, and poverty, continues.

The focus of the partnership between the Government of Sikkim and the Indo Swiss Project Sikkim (ISPS), in the first phase, was on finding technical solutions and building capacities in the extension system to disseminate these. There were several institutional and operational challenges and overtime, a realisation that adaptive research and development methods, participatory technology development and community involvement were important elements for the desired outcomes. The role of ISPS also evolved from an active implementer of the Ginger Pest and Disease Control Programme, to a member of the Ginger Disease Task Force and finally to its present role of advice and support to the Horticulture and Cash Crop Development Department.

The experiences of Dr. Grahame VH Jackson and the ISPS team captured in this document while being based on a specific collaboration, are widely relevant for development practitioners who seek to bridge the gap between the needs of the farmers, available scientific information and the capacities of the extension system. I am sure a large number of readers in Sikkim and elsewhere will find this document useful and interesting.

Rupa Mukerji
Delegate – Intercooperation India
October 2005

Introduction

The Indo-Swiss Project Sikkim was established in 1993 under a bilateral technical assistance programme between the Government of Sikkim and the Swiss Agency for Development and Cooperation. The Switzerland based development foundation Intercooperation was mandated to conceptually and operationally support the project. Horticulture was a component for assistance, with pests and diseases of ginger the focus. The Pre-Phase (1993-1995) saw discussions between the partners – the Directorate of Horticulture and national research organisations – and preliminary activities began. Phase I (1996-1999) concentrated on research and development, followed by Phase II (1999-2002) with its emphasis on extension. This document, *Experiences in Collaboration*, reports on an analysis of the successes and failures of the ginger pests and diseases project from 1996 to 2002, to learn from any lessons that resulted from the collaboration.

Context for assistance

Most farmers in Sikkim plant ginger, invariably with maize, and in rotations with maize and beans, rice, pulses of various kinds, and winter crops of buckwheat, cereals, mustard and other *Brassicas*, and potato. The annual ginger cycle starts with planting from February to April, depending on rainfall. Large farmers plant more than 15 munds (40 kilos) of ginger each year (some more than 40 munds), with smaller farmers, 80 per cent of whom have less than 2 ha of land, planting 5 munds or less. Large amounts of farm-yard manure are used. Most farmers extract *mau*, the planting piece, in July and sell it – a practice unique to the Himalayas. The main harvest can be as early as August, but mostly from October to November, or the crop is left in the ground until January. Returns on the amount planted vary between the four districts. On average, however, a large farmer could expect a return of at least 4 munds for every mund planted, ie a ratio of 1:4. The value of ginger varies greatly – during the project period, prices have seen lows of Rs 200 a mund, and highs of more than Rs1,000 per mund.

Pests and diseases of ginger abound in Sikkim. Their severity, plus the fact that ginger is the only cash crop of a majority of small farmers, was a decisive factor in choosing the crop for ISPS assistance. Rots caused by bacteria and fungi and grubs of insects were common in all districts and often resulted in crop failure. Farmers complained that the chemical control recommendations at the time were not effective.

Worse, pathogens were being spread with seed distributions. Each year, under a Centrally Sponsored Scheme, the State provides some 5,000 beneficiaries with 1 mund of ginger to help them start growing the crop or expand their area of production. There was a need for intervention to break the cycle – diseased seed, diseased crops, diseased seed – and to provide control measures that were appropriate to farmers' cultural practices, and safe to human health and the environment.

Intervention of the ginger project

Based on discussions and activities developed in the Pre-Phase, the partners in the ginger project were the Department of Agriculture (the Directorate of Horticulture in particular), the national research institutes (ICAR, Spices Board and CIPMC) and ISPS. The partners came together at the Ginger Disease Workshop in Gangtok in September 1995 to describe the technical assistance required. A strategic plan was drawn up (initially to 1999, then later extended to 2002) to increase the State's agriculture research and extension capability through training, supplies of equipment, transport and access to expert advice both from within India and overseas. The Ginger Disease Task Force was established to spearhead the work, with representatives from State and national agencies. It was officially sanctioned by Office Order in January 1996. Phase I, from 1996 to 1999, focused on research while Phase II, from 1999 to 2002, focused on extension.

Lessons learned

The establishment of the GDTF was a strategy intended to change the *status quo*, with the GDTF providing the formal collaborating mechanism through which new concepts in research and extension would be introduced. However, the task force approach had its limitations, with the GDTF unable to absorb the training provided or to develop into the expert unit that was envisaged from the outset. Many factors mitigated against success, not least high staff turnover and poor workplace practices that resulted in low performance. The GDTF was unable to influence the spices section of the Department of Horticulture, the healthy seed programme for ginger, in particular. By the time Phase I was drawing to a close in 1999, the *status quo* had not changed, except the creation of awareness that change was needed, and this was being delayed by the GDTF. Thus, its termination in 2000 was apposite, coinciding with a restructure of the district extension services and the creation of specialist posts in the Department of Horticulture. Unfortunately, by that time the principal national research partner had opted out of the collaboration and was conducting research alone. The project solution was to have research carried out by external agencies. Results were achieved, but the chances of establishing a sustainable research capacity in Sikkim were compromised.

While the interest and commitment among the partners at the start of the project to collaborate on ginger research and extension activities were commendable, hindsight shows that a more thorough formulation exercise was necessary than that conducted at the Ginger Disease Workshop in 1995. In addition to detailing the activities, the chances of success should have been thoroughly investigated. Risks associated with project implementation were well defined in reviews carried out during the Pre-Phase, but later ignored in the haste to begin the project. Consequently, the capacity of the State and national agencies to conduct research was exaggerated. In addition, when collaboration broke down, there was no mechanism to make amends, as arrangements between the partners were not clearly defined. The partners went their separate ways, but did similar work. The lack of independent monitoring and evaluation, which might have suggested remedies, only compounded the problems.

However, with its focus on research, there was some measure of success in Phase I: Key pests and diseases attacking ginger in Sikkim were identified and there was some, albeit limited, investigation into their etiology.

- Recommendations were made on the control of dry and soft rot diseases and white grub, appropriate to the prevailing agro-ecological environment of the State.
- Studies provided a better understanding of farmers' perceptions and cultural practices regarding ginger cultivation and pest problems.

The focus on extension in Phase II saw more successes:

- Major improvements were made to the GOS Demonstration Scheme for ginger, under which small growers receive free lots of seed.
- Staff of the Department of Horticulture were introduced to communication theory and new methods of training farmers.
- Leaflets and posters, illustrating the pests and diseases of ginger and their management, were produced to complement the training provided.
- New participatory approaches to extension were tested: Adapted Research Demonstrations were organised, first with two communities and then more widely.

However, the failure, carried over from Phase I, to establish a research capability within the State, remains. National research organisations did not respond to the needs of the Department of Horticulture, and attempts to form a research council capable of directing and monitoring research programmes have been unsuccessful.

The way forward

In 1994, the review of the 'green' sector of Sikkim concluded that a potential role for ISPS could be that of a "think tank cum trial implementer" assisting GOS departments in developing ideas, concepts, visions, strategies and programmes. A venture-type approach was foreseen, where ISPS acts as a catalyst and coordinator. In the event, ISPS did not intentionally set out to play this role in the ginger project, but various factors combined to bring this about. Even though the GDTF concept was not a success overall, the principle of the 1994 review still has merit, and this relates especially to the GOS Demonstration Scheme and to participatory approaches of agricultural extension that are now being tested in Sikkim.

The project's successes, particularly in Phase II, have helped to strengthen the GOS Demonstration Scheme. Seed source farmers are now monitored and district staff are backstopped by a laboratory with trained staff who can recognise disease symptoms and make isolations for more critical determinations. Growers now realise the importance of seed quality and acknowledge that seed from the GOS has consistently improved in recent years. However, the advances made need to be placed in a more coherent framework to ensure standards are maintained. A ginger seed certification scheme is required under The Seeds Act to support staff training, the laboratory, sampling and review. Information on the impact of the Scheme on beneficiaries is still needed and is an important requirement in order to plan further improvements.

The Adaptive Research Demonstrations have shown that, to be successful over a large area, village-based organisations are needed to link farmers with Department of Horticulture staff who are capable of giving up-to-date information on matters of concern to growers. Consequently, the focus of ISPS intervention in Phase III needs to be the application of PTD principles that involve NGOs/CBOs and farmers.

As the consultant to the Participatory Training Workshop with Farmers in October 2001 stated: "strategically, a two-pronged approach is needed, on the one hand re-orienting horticultural staff in participatory processes, while on the other hand enhancing local capacity through farmers' grower groups, empowering them to take greater control of ginger disease management". Farmers have shown a keen interest to be involved in a participatory process, a positive indication of their willingness to take greater responsibility for trying new approaches. The enthusiasm among farmers and village leaders alike augurs well for ISPS in the future. Importantly, its approach is in line with the GOS policy of "less government, reorganised departments and more stakeholder involvement".

The Indo-Swiss Project Sikkim is a bilateral development programme to improve the livelihoods of farming families in Sikkim. ISPS began in 1993, with support from the Swiss Agency for Development and Cooperation and the Government of Sikkim. The Switzerland based development foundation Intercooperation is conceptually and operationally supporting the project.

The State is unique in its geographical position, cultural background, socio-economic potential and development vision. The Government of Sikkim intends to develop agriculture and horticulture so that these sectors contribute to improved livelihoods and greater opportunities for rural communities. The vision of the GOS is described in *Sikkim The People's Vision Document*. This is complementary to the SDC's aims for the region, which are to reduce poverty, develop local structures for the sustainable use of resources and to support good governance.

To support these aims, horticulture was chosen as a component of the ISPS programme, because of its importance to the poor and marginalised farmers of the State. The pests and diseases of ginger were chosen as the focus of the work, to be carried out under a project entitled *Research and Development in Horticulture*.

Since its inception, the ISPS programme has been through a number of phases, reflecting changed objectives and approaches as it evolved over time. A characteristic of ISPS has been its ability to change, to test new concepts and to tackle new issues as these emerged through intensified interaction between the partners during these phases.

After almost a decade, the partners realised there was a need to look back at the work on ginger to capitalise on the project's results. An understanding of what has happened so far is expected to enrich the partnership, guiding it to fresh ideas and innovative approaches.

It is in this context that the document *Experiences in Collaboration: Ginger Pest and Diseases* is to be read. The partnership in ginger research is in the process of entering a new stage where the focus shifts from research carried out by government agencies to one where farmers and farmers' groups assume greater responsibility. This will mean new roles and working relationships for all stakeholders.

A critical reflection on ginger research in Sikkim during the last decade is considered crucial to the formulation of a new strategy, and this document is regarded as an input to that process. It reflects on the technical aspects of ginger research and the process of forming partnerships. These elements have been critical to the results achieved so far.

2. Ginger – the small farmer's crop

Most farmers in Sikkim plant ginger, and for many small and marginalized producers it is their only cash crop. It is planted in small patches in permanently dry fields or in those temporarily rested from paddy, and sold through complex arrangements on markets in Delhi and Kolkata[1].

Although ginger is now a well-established component of the farming system, the early development of the ginger industry in Sikkim is not well documented, especially prior to the merger of the State into the Federation of India.

In the early 1980s, the Department of Agriculture and ICAR reported a modest 640 ha planted with an estimated harvest of 3,200 mt of green or fresh ginger[2]. Ten years later this had risen more than four fold to 3,000 ha yielding 16,000 mt[3]. However, in the following decade production levelled and today's figures are thought to differ but slightly from those of the early 1990s. If these figures are correct, production in Sikkim is extremely low, and in the absence of data to the contrary may have been responsible for the general impression that pests and diseases are factors limiting production[4-5].

An insight into the state of the ginger industry in Sikkim, and the problems faced by growers, was gained in 1998 from intensive investigations into cultural practices and perceptions about pests and diseases[6]. More than 50 farmers from the four districts took part in a year-long investigation and shared their techniques and experiences with staff from the Department of Horticulture. Three categories of farmers were distinguished: large and small growers defined by the amount of ginger planted, and growers who continued to plant despite severe disease outbreaks.

The overall impression was that large growers, in this case those that planted more than 15 munds each year, were managing the crop well. They had sufficient experience and capital to deal with problems when these arose. Importantly, they understood the need for good quality seed, and invariably kept their own from year to year. By contrast, most small growers, and those that had recurring pest problems, found

ginger production much more of a risk. For these people, who represented the majority of growers, the returns from ginger were needed to settle loans, and to pay for household items and other family needs. Such was the need for cash that the entire crop was often sold at harvest. Later, at planting time, seed was bought from the market or again obtained on loan. Good quality seed was rarely used, as it was expensive. Worse, many growers did not practise seed selection, resulting in the use of poor seed, diseased crops and low yields – a cycle that was difficult to break.

Although important, diseases are not the only worry of small farmers. They are also concerned about insufficient land for adequate crop rotations, shortage of

labour at critical times due to the drift of workers from the land to towns in search of more attractive employment, insufficient farm-yard manure, and market price fluctuations creating a disincentive to production. Of all the concerns, however, the greatest was the difficulty of obtaining good quality seed at a reasonable price. This is critical to growing healthy crops of ginger. But despite the problems, the farmers interviewed indicated their intention to continue to cultivate ginger, as they considered there was no alternative cash crop.

3. Economic importance of ginger pests

Although there was a perception that pests and diseases were important in Sikkim(as they are in other states of India), it was not until 1994 that a definitive statement was made on crop losses after surveys had been carried out in the State. Studies reported by ICAR found that 15-35 per cent of the plants were infected by soft rot, in fields that were managed poorly and drained badly, losses were up to 50 percent[7]. A species of *Pythium*, *Paphanidermatum*, was found to be the cause[8]. Losses of this magnitude would result in substantial yield reduction, although accurately predicting crop losses is often fraught with difficulty[9].

Assessment of the economic importance of ginger pests in Sikkim is also complicated by the cultural practice of *mau* extraction[10], a procedure unique to the Himalayas, which is carried out by 80 per cent of the farmers[11]. The planting piece (*mau*) is removed when plants have three well-formed shoots, usually between June and August. The intention is to capitalise on the higher price of ginger at this time. In fact, large farmers may forego sales at the main harvest, especially if prices are low, preferring to keep a larger portion of the harvest as seed, to replant and benefit from the higher price of *mau* mid-season. To small farmers, the opportunity to sell *mau* may be crucial to their decision to plant ginger. It minimises the risk of crop loss from pests and diseases, and guarantees some return from investment. There is also the chance that the amount harvested is higher than that planted as *mau* extraction coincides with the monsoon when the rhizomes, planted in the dry season, may have higher water content.

The practice of *mau* extraction does have one unfortunate aspect, other than its potential to exacerbate disease. Farmers will often plant seed that is diseased rather than sell it in the market for an inferior price. Although they realise the seed is of poor quality, they know that there is a chance that it will gain value in the field, and there is always a possibility that the crop will reach maturity, further increasing financial returns. However, farmers do not appear to realise that by planting diseased seed they are transferring pathogens to the soil to the detriment of the next crop and/or the next time that ginger is planted in the rotation. If farmers do realise the risk, they prefer, presumably, a short-term gain to the longerterm benefit of maintaining land that is relatively pathogen-free.

The practice of *mau* I extraction undoubtedly complicates any assessment of the economic impact of pests and diseases, but so, too, does the problem of pest diagnosis by inexperienced extension personnel. Surveys carried out in 1996 and 1997 yielded little data that could be analysed statistically. The surveys also showed how difficult it was to measure yield in farmers' fields: it required extension staff to be present at harvest, which was often impractical to arrange, or for farmers to assess their own harvest, which was equally problematical. A better approach, and the one adopted during the ISPS Pre-Phase PRAs and in the 1998

survey of farmers' cultural practices and perceptions, has been to discuss pests and diseases with farmers to determine their impact, and to assess yield as a ratio of harvested rhizomes to the quantity planted. This has led to some interesting insights and probably a more accurate view of the pest and disease situation throughout the State. But it is often only an estimate, a snapshot of prevailing trends: for a variety of reasons farmers exaggerate or minimise the yields they obtain.

A CASE STUDY:
IMPACT OF DISEASE AT NANDU GOAN

In 1998, and with a better knowledge of the crop, the impact of pests and diseases was assessed in discussions with growers. The situation found at Nandu Goan is common to many areas of the State, and gives a good indication of the impact of one disease. Nematode infestation causes severe dry rot in the village. One farmer reported that 7 munds were planted in 2000 and only 10.5 munds were harvested. From this, 6.5 munds were of good quality; the rest was rejected due to dry rot. At the time of planting another 1.5 munds will be rejected and sold. The market price for the rejected ginger is 50 per cent lower than that for healthy rhizomes. The effect of dry rot in this village is substantial, and it is surprising that farmers are still growing the crop, as yields are so low. Nandu Goan is also a village where severe infestations of white grub have occurred in the past.

The PRAs in 1994, referred to above, showed that where ginger was a relatively new crop, as at Martam, losses were not yet serious, although farmers were beginning to notice the effect. By contrast, most farmers at Sorok, a village where ginger had long been cultivated, had abandoned the crop due to a disease that had come suddenly in the late 1980s[12]. More detailed PRAs in 1995, carried out as part of the preparation for the Ginger Disease Workshop compared Bikmat (south district) and Tarpin (east district). Differences were considerable, with the area of production increasing slightly at Bikmat (although occasional outbreaks of white grub seriously reduced harvests)[13], whereas at Tarpin the area under ginger had decreased by 40 per cent in the previous 5 years due to bacterial wilt, with those farmers still growing the crop reporting harvests reduced to one or two times the amount of seed planted.

Later, in 1998, the year-long, State-wide, cultural practices and perceptions survey confirmed the findings of the PRAs and showed that more than 60 per cent of the farmers thought that diseases were a major problem, although they were not the only factors limiting production[14]. The economic impact of the pests and diseases, however, was not reported, although the survey found that 30 per cent of the small growers (growers receiving seed under the GOS Demonstration Scheme[15]) harvested early and did not keep seed for replanting – usually a sign that dry rot caused by the nematode, *Pratylenchus coffeae*, is attacking the roots and causing early death of the plants, or that bacterial wilt, caused by *Ralstonia* [*Pseudomonas*] *solanacearum*, is present.

3.1 Early studies into pests of ginger

Studies on the etiology of pests and diseases and their control generally have been the remit of ICAR, since the station was established at Tadong in 1976. ICAR is mandated to conduct basic and applied research in agronomy, soil science, pathology, entomology and animal husbandry, taking responsibility for these functions in

the absence of any agriculture research capacity within the GOS or any State university. Priorities for research and reviews of achievements are discussed at the State Coordination Committee, a twice-yearly meeting of ICAR and crop and animal husbandry departments.

Surveys were first done in 1988 and 1989 to identify the main pathogens of ginger in the State. Bacterial wilt (caused by the bacterium *Ralstonia* [*Pseudomonas*] *solanacearum*) was reported as a serious disease in the Rhenok area; root knot nematode (*Meloidogyne spp.*) was also a problem and losses of 75 per cent from white grub (*Holotrichia spp.*) were reported from Bikmat, in the south district[16,17]. A report was submitted to the Secretary of Agriculture and an extension article published[18]. Later, in 1994, *Pythium*, a soil-borne fungus prevalent in wet weather, was said to be the cause of rhizome soft rot, the "most devastating disease of ginger in the state", and fungicides were suggested, applied as soil drenches[19]. A review of the 'green' sector at this time also noted the work on variety screening at ICAR, although the particular pests were not stated[20]. Similar work was being done within the Directorate of Horticulture[21] at Bermiok, Kamling and Kitam Horticulture Farms, where clones that had survived unspecified rhizome rot diseases in farmers' fields were being tested. This period of investigation into ginger diseases by ICAR coincided with the ISPS Pre-Phase (March 1993-October 1995). PRAs were conducted at four sites in November 1993 to gain a better understanding of the livelihoods of farmers in southern Sikkim at an early stage of project planning[22]. Of the four villages selected, ginger was a major crop in one (Martam), gaining in importance in the second (Luing), declining in the third (Sorok) and less important in the fourth (Ralang).

In the relatively remote village of Martam in the west district, ginger was the most important crop of small farmers, grown within a farming system characterised by a wide variety of crops. Few production constraints were noted at the time, although diseases were increasing in significance. A totally different situation was found in Sorok in the dry belt of the south district. Here, ginger had been cultivated since 1967, and during the 1970s the area became known for good production and quality, a situation that continued until 1988, when the crop was struck by serious pest problems. From that time, most farmers stopped growing the crop. Applications of fungicides supplied by the Department of Agriculture or changes in methods of cultivation by farmers failed to provide any measure of control. In Luing (east district), ginger was cultivated by a quarter of the households. Here, too, diseases were prevalent, although not to the extent noted at Sorok and cultivation was said to be increasing rapidly. At all sites, there was only limited advice from extension specialists (VLWs, in particular) on ways of controlling pests and diseases of ginger. The village-based extension staff provided pesticides, but farmers were realising that pesticides were of little or no use in solving the problems.

The recognition that pests and diseases were limiting production of ginger, in certain areas of the State at least, led to their inclusion in the 1995 YPO under an extension of the ISPS Pre-Phase. The first requisite was to obtain the results of research done in the State (although it was recognised that little had been done), from other parts of India as well as other countries. The second requisite was the formation of three sub-committees in February 1995, with members from ISPS, the Department of Agriculture and ICAR. The sub-committees were asked to undertake: 1) a literature review of ginger pests and diseases (including visits to major ginger research establishments in India), 2) field surveys and laboratory analyses of diseased plants and soil, and 3) PRAs (Bikmat and Tarpin) on farmers' production practices and perceptions.

The reviews and other papers produced by the sub-committees[23] were used as inputs for a synthesis paper[24] prepared by an external consultant who later assisted at a planning workshop in Gangtok. The Ginger Disease Workshop, 12-13 September 1995, was attended by all the State research institutes and staff of the Department of Agriculture. It reviewed the synthesis paper and outlined a 3-year research and extension strategy for implementation by the Directorate of Horticulture in collaboration with ICAR[25].

3.2 Developing a research programme

3.2.1 Assessing pests and institutional capacity

Members of the Directorate of Horticulture, ICAR and ISPS undertook further surveys in the State, 7-9 September 1995, prior to the Ginger Disease Workshop. They were done to check previous findings in east and south Sikkim, in particular.

Farms in the Rhenok area and those at Bikmat, Bermiok, Sorok and elsewhere were visited, as well as the Directorate of Horticulture farms at Kitam and Bermiok.

The surveys confirmed that bacterial wilt was the major disease in the east, whereas in the south the problem was yellowing of foliage associated with a bud or 'eye' rot of the rhizomes. It was present in all the villages visited (Namthang, Bikmat and Suiram). At that time, the cause of the disease was unknown[26]. Symptoms differed from published reports of those of *Pythium* soft rot and *Fusarium* yellows, and, importantly, the symptoms were not recognised by ICAR scientists who had carried out previous surveys and isolated fungi associated with rhizome soft rots. In a majority of cases, yellowing of the plants was from the top down, whereas in all published descriptions of *Pythium* soft rot, death of leaves is from the bottom up. Bacterial wilt was often present in fields with 'eye' rot.

The surveys confirmed that white grub was a major problem: for instance, in farmers' plots at Bikmat, four or five larvae were seen attacking individual plants. By contrast, other pests were of minor importance. Symptoms of root knot nematode were common, leaf spots caused by *Phyllosticta* were present everywhere, and occasionally frass from stem borers was seen.

In addition to the district surveys, field plots at the ICAR complex at Tadong were visited. The site had been used for fungicide trials against *Pythium* in previous years. In 1995, plants were being

BUT IT'S NOT JUST ABOUT GINGER PESTS AND DISEASES

As the 1995/96 YPO says, ginger pests and diseases were selected as a "pilot venture", rather than other possible interventions (eg orange die-back or virus diseases of cardamom), given that ginger is the foremost crop of tenants, small and medium farmers. Relatively little work had been done on the crop in the State, and control measures advocated by the extension service were, seemingly, ineffective under farmers' conditions. The choice of ginger as a focus of attention was also made because the Directorate of Horticulture and the Government of India research institutes (ICAR, Central Integrated Pest Management Centre and Spices Board) were all equally concerned about the seriousness of the pest and disease problems. This being so, support from ISPS was intended to stimulate collaboration and cooperation among them. Ginger pests and diseases were to be used as a vehicle to bring the State resources to bear on a serious issue in a way that had not been possible before. This was an important aspect of ISPS intervention.

The complexity of the problem was noted from the outset, and that considerable resources would be required to find solutions; in addition, a restructure of extension services would be needed in order to provide information to farmers in useful ways. This meant that institutional arrangements for the conduct of research and the transfer of results to farmers were as important as the investigations into the etiology and control of ginger pests and diseases. The 1995/96 YPO states: "Once feasible solutions have been elaborated they will be fed into the extension system – for which purpose then the appropriate participatory approach will have to be developed".

decimated by bacterial wilt. Inspections also found plants introduced for evaluation from research stations in other states that had symptoms of ginger chlorotic fleck virus[27].

The impact of the pests and diseases in farmers' fields was considerable. Only one of eleven fields inspected in east Sikkim was free from bacterial wilt. In most instances, the farmers had already harvested, or they were in the process of doing so. Farmers were well aware of the seriousness of the disease and its potential to destroy the entire crop. Rather than risk complete loss, they were harvesting 2-3 months earlier than usual. Not only were yields said to be very low because of the

impact of disease and early harvest, but also the lack of healthy seed for the following year was of major concern.

'Eye' rot in south Sikkim appeared to be equally devastating as bacterial wilt in the east. In many crops examined, a majority of plants were affected and they were dying. Informants said that before the disease first occurred in the 1980s, they would expect a ratio of seed planted to crop harvested of more than 1:4; now it was 1:2.

3.2.2 Conclusions from the pest surveys

The surveys prior to the 1995 Ginger Disease Workshop found that:

- Diseases are severe and widespread, and farmers are virtually powerless to do anything about them (except to use a 3-4 year rotation, and in some cases rogue infected plants). They do not follow Department of Agriculture recommendations. They neither treat their planting material, nor apply fungicides as drenches to disease-affected plants in the field. Those that had done so found that they made no difference.
- Even if growers want to use their own seed it is often not possible because of the high incidence of disease (they harvest early and sell what they can). As a result, they are forced to purchase from other farmers, the market or, if selected, they receive seed under the GOS Demonstration Scheme. All these seed sources may be diseased, thus perpetrating their problems.
- There did not appear to be any clear correlation between taking *mau* in July and August, and the incidence of disease. Undoubtedly, *mau* extraction damages roots of ginger and this may help the entry of pathogens. However, it is also possible that high levels of disease are due to high rainfall, and the occurrence of disease at the time of *mau* extraction is a coincidence.
- Seed is kept in the ground until January when it is harvested and placed in pits ('big' growers especially), or stored in the house or shed. Only rhizomes from crops without disease store well; rhizomes from diseased plants shrivel.
- Some farmers are still growing healthy crops of ginger. Asked why, they said it was because of healthy seed and a rotation of 5-6 years. Conversely, they considered diseased crops to be caused by growing consecutive crops of ginger in

the same land, and applying fertiliser (but not universally agreed) or using rice paddies where soils were waterlogged.

3.2.3 Institutional capabilities

3.2.3.1 Research

In 1995, the Department of Agriculture had seven scientist posts: entomologist, plant pathologist, mycologists (2), soil scientist, agronomist and research assistant. Only the research assistant had full-time research duties, with many of the other posts filled by non-scientists. There was some, albeit limited, funds for adaptive research trials and demonstrations at the government farms, but there was no separate allocation for ginger. In the past, research was carried out at Ranipool, where there was a laboratory with basic equipment associated with mushroom culture, but the facility was no longer available to the Directorate of Horticulture. A tissue culture laboratory existed at Tadong that was not utilised. In the long term, an integrated pest management complex was to be established by the Department of Agriculture[28].

In addition, there were 20 Government Farms, Regional Centres and Sub-centres used for multiplication purposes, demonstrations and adaptive research, but there was a lack of technical staff, operational budgets and transportation. Research emphasis was on field crops (rice, maize, wheat, oil seed, pulses), and horticultural crops (vegetables, spices - ginger, turmeric and cardamom - fruits, flowers). Most research was done by GOI-financed institutes: ICAR, CIPMC and Spices Board, coordinated through annual (or more frequent) meetings with the GOS. However, a weakness noted in the arrangements was the infrequency of consultations with ICAR, in particular, in recent years[29].

The paucity of research personnel within the Directorate of Horticulture was recognised by the GOS, and that increased collaboration with ICAR on horticultural crops (cardamom, ginger and oranges) was required. In order to develop this, new working arrangements with the State were proposed, whereby ICAR staff would spend 25 per cent of their time working with growers and conducting on-farm trials[30]. The association with ICAR brought the Department of Agriculture into close contact with the transfer of technology programmes of the Krishi Vigyan Kendra, and the model village concept promoted by the KVK. In the State's 8th Development Plan, a budget allocation had been made to expand the concept into each of the four districts[31].

3.2.3.2 Extension

At the time of the planning workshop in September 1995, senior staff in the headquarters of the Directorate of Horticulture included a director, additional director, joint director, two deputy directors and a project officer. Some of these officers were subject matter specialists involved in GOI and State sponsored schemes for spices. In each of the four districts (north, south, east and west), horticulture was supported by a deputy director and a project officer. A plant protection officer was stationed at Namchi for the south district. In addition, there was one horticulture officer in each of two sub-divisions per district. There were also 41 horticulture inspectors and two Village Level Workers located throughout the State. These persons were stationed mostly on government farms and were in charge of 4-6 blocks, each of approximately 500 households. To support extension activities, pool vehicles were available to deputy directors and project officers, but not to horticultural officers or other staff.

A SWOT analysis by the Directorate of Horticulture and ISPS staff in 1995 found that the major strengths of the extension service were its well-qualified personnel, adequate funding, and clients – highly responsive farmers. A further strength was the division of the Department into two directorates (later separate departments of Horticulture and Agriculture), reflecting the importance of horticulture in the economy

of the State, and the likelihood of continued funding. Major weaknesses included GOS policies being determined to a great extent by centrally sponsored schemes; staff postings sometimes not being done according to qualifications or skills; limited mobility for staff in rural areas; and little consultation with growers. Although there was an awareness of the latter, it was not clear how interaction with growers might be changed for the better[32].

In terms of support for the ginger industry, further deficiencies were noted:

- Inadequate information on diseases, their distribution and relative importance.
- Insufficient advice on disease control practices – what is available is not relevant[33].
- Poorly informed extension staff who lacked confidence when giving advice on pests and diseases of ginger to growers – as a consequence, growers considered the advice (if provided) to be of little value.
- There was a complete lack of training materials on ginger and its pests and diseases (as well as those affecting other crops).
- Growers did not have access to disease-free propagating stocks[34]; instead they obtain seed from fellow growers or from markets – as a consequence, diseases were spreading as well as increasing in severity.

On the positive side, funds were available for ginger development under a CSS[35]. All India Radio was used to give farmers advice on agricultural matters, and a ginger crop calendar had been produced and distributed widely. However, the relevance of the advice and information provided was questionable, and the GOS Demonstration Scheme that was set up to provide farmers with healthy planting material did not appear to be giving satisfactory results. Source material was not being checked properly, and crops derived from the selected seed were not being monitored. Diseases were rampant in fields of seed-source growers as well as in those of beneficiaries under the GOS Demonstration Scheme.

4.1 1996–1999: ISPS Phase I

The Ginger Disease Workshop, 12-13 September 1995, developed a strategic plan that aimed to improve ginger production in Sikkim. The strategic plan would provide the GOS with a vision for the ginger industry in the foreseeable future, with annual plans setting the milestones for reaching the stated goal. In order to arrive at the desired results in a timely and coordinated fashion, activities essential to achieving the objectives were defined, responsibilities agreed, and details provided on the resources required.

The establishment of a coordinating mechanism to integrate research and extension efforts towards achieving the goal was considered critical. Without it, there would be little chance of making an impact on the serious pest and disease situation that existed. The creation of a Ginger Disease Task Force was proposed and agreed by the Workshop. It would comprise a small number of officers drawn from the research and extension establishment of the Department of Agriculture who had extensive experience of spice crop development programmes. They would be released from their usual duties for the duration of the strategic plan and have the resources and the necessary authority to carry out activities prescribed by the GDTF. A senior member of the Directorate of Horticulture would be selected as the Task Force leader, with the Director as Chairman.

The Workshop considered it important to have performance measures to monitor activities, and to evaluate how well they were being carried out. These would allow remedial action to be taken in a timely manner on one part of the plan without jeopardising other components.

In the final session of the Workshop the strategic and first year plans were presented to the Development Commissioner and the Minister of Agriculture. The Secretary of Agriculture spoke of the necessity for a task force to deal with the urgent need to improve ginger production practices. He requested permission from the Development Commissioner to form the GDTF as well as financial support from the State budget in 1996. The Secretary also spoke of the need to strengthen the research capability of the State in order to complement the work of ICAR and other national institutes.

The Development Commissioner emphasised the significance of ginger in the State and reaffirmed that it remained an important thrust of the Government's attempt to assist small farmers, 80 per cent of whom had less than 2 ha of land. In 1994, considerable resources were provided for ginger improvement. He acknowledged the importance of pests and diseases and the impact they had on production. He considered the idea of a task force was the right one. Its existence would focus

PROJECT DESIGN

The projeet goal was to develop a ginger industry in Sikkim that is free from serious diseases.

There were three objectives:

1) To conduct R & D programmes into ginger pests and diseases and appropriate control measures
   - ❒ Outcome 1: better understanding of ginger diseases and effective control procedures
     - ▼ Identify major diseases and their distribution
     - ▼ Develop environmentally sound control procedures
2) To provide advice and support to growers and the community on ginger diseases and control measures
   - ❒ Outcome 2: improved extension, grower and community awareness of ginger pests and control procedures
     - ▼ Develop skills of extension staff
     - ▼ Provide information/advice to growers
3) To provide support to the Directorate of Horticulture and other implementing agencies so they can effectively and efficiently manage the project
   - ❒ Outcome 3: coordinated strategic approach to ginger improvement established
     - ▼ Establish and maintain a GDTF

attention on the pests and diseases and help to provide control measures, and it would also assist in the Government programme of seed distribution to needy growers. With the establishment of a task force, the quality of the seed distributed would be more scientifically determined.

4.1.1 The GDTF and its work programme

The concept of a task force was an acknowledgment that agriculture research and development of State agencies were weak, and that a task force properly trained, and with a focus on ginger pests and diseases, would complement the work of ICAR and other national institutes. Financial assistance from the GOS was promised in order to stimulate adaptive research and to assist in improving the State's seed distribution programme, in particular. An Office Order officially established the GDTF in January 1996 and, subsequently, terms of reference were developed in discussions with its members.

Technical capacity building and the development of operational and organisational skills were identified as important components of the GDTF programme from the outset. There was also the need for regular dialogue with ICAR and other national institutes[36]. ISPS provided funds to the Directorate of Horticulture for a vehicle, regional trials, staff training and technical expertise to backstop the programme. As a result of ISPS and Directorate support, the tissue culture laboratory at Tadong was refurbished to carry out research into ginger pests and diseases. Microbial transfer and culture rooms were built, the facility rewired and equipment purchased. In addition, offices were provided for GDTF staff and meetings. In this way, all members of the GDTF could operate from one place instead of working in different offices in Krishi Bhawan. The location of the laboratory, adjacent to the ICAR complex at Tadong, had the advantage of being close to the technical expertise offered by the Institute.

To assist in communications with the districts, telephones were provided in the office of the Team Leader and the laboratory; later, the laboratory was provided with email. Terms of reference were developed for the laboratory by the district joint directors, agreed by the Secretary of Horticulture and endorsed by the Development Commissioner. The laboratory was considered a key to changes in the GOS Demonstration Scheme, in particular, by providing a diagnostic capability that district staff could access easily.

The formation of the GDTF also saw a schedule of reporting of ginger activities established. Monthly meetings were planned with district staff, and quarterly reviews were scheduled between the GDTF Team Leader, Chairman (Director of Horticulture), Secretary of Agriculture and ISPS. An evaluation was planned for the third year.

As a specialist unit within the spices section of the Directorate of Horticulture, the GDTF was conveniently located to implement the programme. The GDTF contained senior staff who were in charge of GOS programmes on spices, including the ginger CSS through which approximately 5,000 growers received free planting material each year. Thus, the GDTF had a link to farmers and was well placed to secure funding for its own activities under the CSS. It was also in a position to make changes to improve CSS impact. Led by an experienced Joint Director, it was considered that advice from the GDTF would be readily transmitted to district staff and become part of the extension programme. Furthermore, GDTF links to the research institutes of the State (ICAR, Spices Board and IPM) were well established: the Research Assistant of the Directorate of Horticulture (the only trained plant pathologist in the GOS establishment) was a member of the GDTF from the outset. For its part, ICAR was keen to assist, having played an active role in several surveys preceding the Ginger Disease Workshop[37].

Beginning in 1996, laboratory and field trials were carried out to find methods of controlling the pests and diseases as well as understanding their etiology. Initially, the GDTF undertook surveys in the main ginger growing areas of the State, to identify villages relatively free from ginger diseases that could be used as seed sources for the GOS Demonstration Scheme. For the first time, fields would be monitored to check plant health. In the process, extension staff would be trained in pest and disease recognition as well as in ways of communicating research results to farmers (Fig. 1). It was envisaged that if the GDTF concept was successful, it might evolve into a general disease prevention and control cell in the Directorate of Horticulture[38].

4.1.2 Backstopping the GDTF programme

The work of the GDTF received external support from many sources. An overseas consultant visited regularly to assist the Directorate of Horticulture in the development of annual plans and to maintain consistency in the ongoing monitoring. Additional support to the research programme came from IISR. From 1996, the principal plant pathologist (later Director) of IISR backstopped the research, visiting Sikkim twice a year. Other subject matter specialists from IISR made periodic visits.

A long-term research consultant (a post-doctoral fellow) recruited by IISR began work in April 1998 to train laboratory staff and to investigate the possibility of biological control of ginger diseases (*Pythium*, in particular). A former member of the Citrus Dieback Research Station, Kalimpong, provided similar long-term support in nematology. This improved the skills of laboratory staff in nematode identification, pathogenicity testing and field monitoring. Statistical advice from

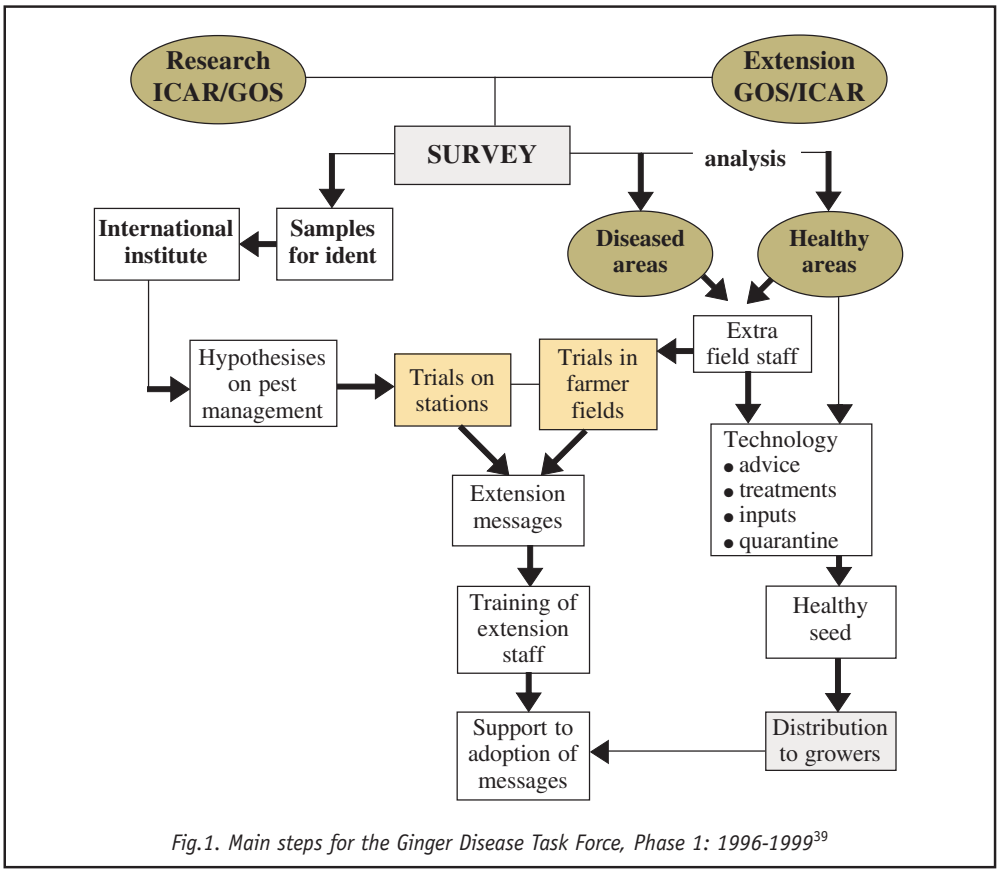

Fig.1. Main steps for the Ginger Disease Task Force, Phase 1: 1996-1999[39]

local and overseas consultants was also given to the GDTF for the design and layout of field trials, and the analysis of results.

In addition, support was provided by overseas institutes, often without cost, for the identification of microoganisms and insects, and for advice and information over a wide range of issues. In this regard, the Central Science Laboratory, Sand Hutton, York, UK; CABI Bioscience, Egham, UK; and the project for the *Management of white grubs in peanut-cropping systems in Asia and Australia*[40], University of Jaipur and DPI, Queensland, Australia (ACIAR-funded), have been most helpful.

4.2 1999–2002: ISPS Phase II

4.2.1 Change of direction: the GDTF disbanded

The first phase was seen as developing "concepts, strategies and implementation plans for the technical programmes; organisational restructuring where required; skill development in planning and management ....."[41]. In Phase II, the focus was towards extension.

Meetings with the GDTF in December 1998 discussed the overall concept of Phase II, and the following objectives were developed[42]:

- Carry out a research programme into ginger pests and diseases relevant to district extension staff and growers.
- Provide rural households with knowledge, skills and practices, enabling them to be more self-sufficient in ginger production, by:
  - training extension staff in communication methods and technological aspects of pest control;
  - establishing and maintaining the effectiveness of a quality seed program in Sikkim; and
  - encouraging ginger grower groups and farmer-led experimentation.
- Develop a regional ginger network to foster collaboration in the control of ginger pests and diseases, and to monitor the spread of those that threaten production in Sikkim.
- Provide efficient and effective management and monitoring.

Thus, at the beginning of ISPS Phase II in 1999, major changes were envisaged to the ginger disease control programme[43]. In order to achieve the objectives, the GDTF was "to evolve from an implementing into a coordinating, monitoring and extension unit within the Department of Horticulture that assists the districts in the implementation of ginger disease and pest control programmes as developed in the seasonal action plans"[44]. Ginger growers' groups, considered important in linking research activities with farmers' knowledge, would be encouraged to improve interaction between the Department and producers.

The Phase II plan realised the "presently insufficient research capacities within the State, and, in view of building up such capacities in the medium term, research in ginger pests and diseases and environmentally sound control measures will be out-sourced to a qualified national research organisation"[45]. The research results would be analysed, conclusions drawn and findings translated into extension messages. Annual plans would be developed, reviewed by senior staff of the Department of Horticulture and ISPS and integrated into ISPS YPOs.

Research activities were to be conducted both in the GDTF laboratory and at the national research organisation's laboratory: "a senior scientist of the research organisation will maintain the overall conceptual guidance of the research programme, provide the necessary scientific inputs and make available a long-term post-doctoral consultant to supervise research activities within the State and build-up local research capacities through on-the-job training of the DOH research staff"[46]. The intention was for research to have an integrated pest and disease management approach, minimising the use

of agro-chemicals, and emphasising biological control measures, appropriate to prevailing conditions in Sikkim.

The discussion also agreed on the expected outcomes for Phase II, as follows[47]:

- Research into causes and treatments conducted according to an overall concept, and basic capacities within the Department of Horticulture will have been developed.
- Extension messages to control ginger diseases formulated and made available to farmers through the Department of Horticulture extension system; in selected areas where farmer groups have been formed, ginger disease control measures will have been adopted resulting in enhanced production, and the availability of quality seed.
- Ginger production and ginger pests and diseases will have been addressed at a regional level through established institutional links.

A year later, with the retirement of the Team Leader and the transfer of staff to new duties, the GDTF was disbanded. These developments coincided with a major restructure of the Department of Horticulture, with the creation of district research positions at the deputy director and horticulture officer levels. With assistance from ISPS, a new extension approach was developed, focusing mostly on improvements to the CSS (Fig. 2). This was the beginning of participatory research with farmers.

Basic research continued with laboratory and field trials under the care of the Long-Term Research Consultant, backstopped by IISR, but only until February 2001.

4.2.2 Healthy seed: improving the GOS Demonstration Scheme

From 1999, renewed emphasis was placed on the importance of healthy seed provided under the GOS Demonstration Scheme. A review of the programme showed its complexity and areas where improvements were required[48]. The restructure of the district extension service, a better understanding of the cause of ginger diseases based on district trials, and the recruitment of new laboratory technicians working under the guidance of the Long-Term Research Consultant, meant that it was now possible to make radical changes to seed source and recipient monitoring, important components of the Scheme.

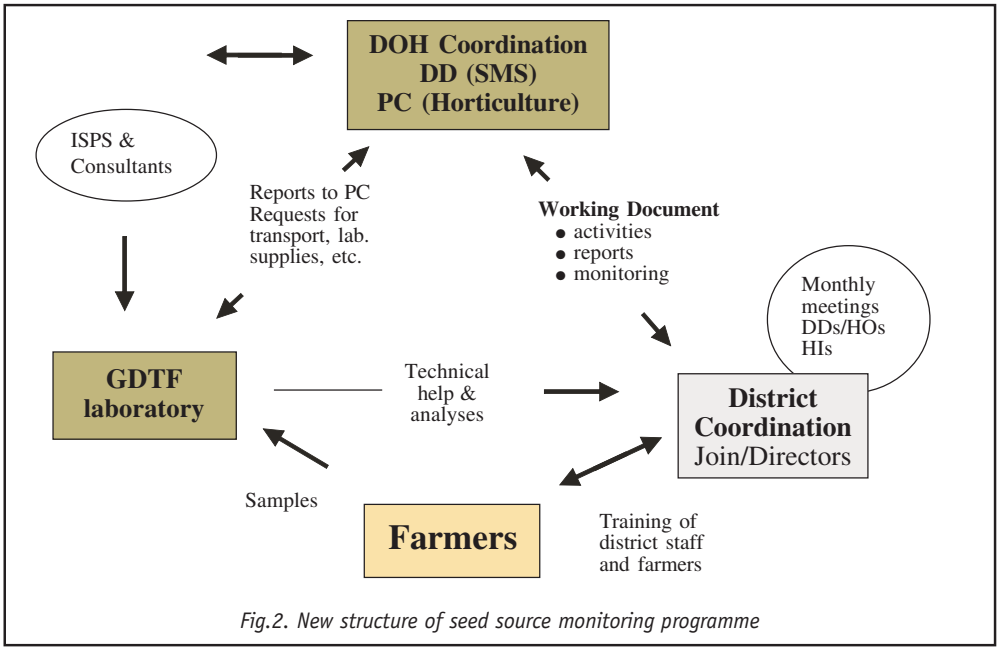

Fig.2. New structure of seed source monitoring programme

CENTRAL SPONSORED SCHEME FOR GINGER (GOS DEMONSTRATION SCHEME)

The ginger CSS (later renamed Technology Mission) is a complex programme using funds from the GOI to expand the ginger industry of Sikkim. The aim is to provide farmers with healthy planting stocks to improve yields and create an incentive to continue cultivation in subsequent years.

Annually, the Ministry of Agriculture, GOI, provides an allocation to the Department of Horticulture, Sikkim, for spices development. The funds are transferred in instalments, with the total provision known in April or May. In 2000, for instance, the amount provided was Rs112 lakhs. This allowed the Department to set a target of 4,000 'demonstrations', each of about 1 mund, with an all-inclusive amount set at Rs1,200 per mund. In addition to the purchase of seed, the Scheme allows for pesticides, tools, transportation, and a nuclear seed programme at two GOS farms.

Coordination of the Scheme is the responsibility of the PC, assisted by the Deputy Director Spices – a subject matter specialist of the Department of Horticulture. Implementation in the districts is the function of the Joint Directors, who hold monthly meetings with other staff to plan and review progress.

A meeting of central and district staff from the Department of Horticulture in July 1999 outlined a plan to improve the healthy seed programme. Job descriptions of all the actors involved, from Field Men to Joint Directors, were developed and agreed. Activities were identified and detailed, and together with job descriptions were published in a Working Document, which was distributed to all district staff. Later, meetings were held in each district between the PC of the ISPS programme and senior district staff to formulate plans for the coming season. The district Joint Directors also provided terms of reference for the laboratory, describing its analytical and backstopping functions. In 1999, for the first time, samples were sent from the field to the laboratory for disease analysis.

Initially, it was decided by the Department of Horticulture that only 'big' growers, those who planted in excess of 40 munds, would be considered as seed sources. Subsequently, in a revised Working Document for 2000, this was revised to 15 munds, to have sufficient seed for the Scheme. It was decided, too, to inspect seed source growers on three occasions in each season (in August, October and January), and to note the incidence of disease.

The presence of bacterial wilt excludes a farmer from being a seed source, unless there are exceptional circumstances[49]. A small percentage of *Pythium* soft rot is allowed, as long as inspectors are satisfied that farmers will exclude seed from infested areas at harvest, and also carefully inspect the remaining seed, removing any that may be diseased. The final field inspection, in January, is to check for the presence of dry rot, caused by *Pratylenchus* nematode. Samples are to be sent to the laboratory only when the inspectors are in doubt as to the nature of disease. At the end of the season, the laboratory compiles a list of healthy seed sources and this is sent to the PC and then to the district staff.

The Department of Horticulture is constantly making improvements to the Scheme. In 2002, it considered new ways of selecting seed source growers. Village meetings, or Gram Sabhas, were suggested at which farmers would nominate ginger growers who, by common knowledge, invariably produce healthy seed, and who would allow other growers in the village to monitor their ginger crops. Although an attractive idea, it may be difficult to put into practice. MLAs and Panchayat members select the beneficiaries, but not until near the time of seed distribution; and beneficiaries may not necessarily be selected from every village. This could mean that farmers select seed source growers in a village for the Department of Horticulture to monitor, but they may not benefit. However, if the subsidy scheme is phased out in a few years time, as seems likely, it makes sense to develop a close

relationship between seed source growers and those who are likely to purchase the seed. Good quality seed is always in demand.

The registration of seed source growers is also under consideration. If it is done, it will overcome the present difficulty where district staff do not know how much seed to monitor. When the price is high, farmers often sell to the market rather than wait for the Department of Horticulture to buy their crop. When the price is low, the staff may be faced with a glut, and pressure from farmers to buy their seed. Registering growers, with the intention of purchasing their seed, irrespective of market fluctuations, would be advantageous for both farmers and the GOS Demonstration Scheme.

CHANGING ROLE OF ISPS

The role of ISPS has changed from being actively involved in the implementation of the entire Ginger Pest and Disease Control Programme – by the ISPS Project Executive being a member of the GDTF – to one of providing advice and support to Department of Horticulture personnel. The GOS Demonstration Scheme – of which seed source monitoring, training of district staff and farmers, sample analyses, and participatory research are key components – now defines this assistance.

From 1996 until 2002, field trials were carried out in three districts (south, east and west) to test methods of controlling pests and diseases using healthy seed in combination with seed treatments, including chemicals, hot water and biological control agents. GDTF members were trained in the identification of fungi, bacteria and nematodes[50], and later carried out pathogenicity tests to determine the cause of the diseases. In order to support the research, and to gain a better understanding of the production practices and farmers' perception of pests and diseases, surveys were carried out in all districts[51]. The significant achievements were:

- The identification of the insects and pathogens affecting ginger production in Sikkim.
- Control measures against three pathogens and one insect pest investigated.
- A laboratory established, within the capability of the State to maintain, and staffed by trained technicians capable of backstopping the GOS Demonstration Scheme (including the isolation and identification of ginger pathogens, and the diagnosis of diseases in the field).
- A move from on-station and on-farm trials towards experimentation and the development of technologies with farmers.

5.1 Relating symptoms to cause

Bacterial wilt:
At first, symptoms occur on a single plant or on plants in a small patch. There is a downward curling of the leaves, without any marked yellowing, and quickly the leaves turn orange-brown or golden-brown. They then collapse and hang down around the stem. This gives the appearance of wilt. If these stems are placed in water, a white substance streams from the cut ends.

Stems become infected at the base, near the rhizome. Dark, water-soaked patches occur, and soon after the stems can be pulled easily from the rhizomes. Usually, the rotten stems have a foul smell.

The young, tender, sprouts of the rhizomes are also infected. Water-soaked areas occur (arrowed in picture above), and a milky liquid oozes out when rhizomes are cut. At harvest, there is nothing left of the plant or only the skin remains; everything else has been destroyed by *Ralstonia* and other organisms. Isolates were sent to the UK in 1996 and identified as *Ralstonia solanacearum biovar 3*. This was confirmed during a visit to Sikkim by an IISR scientist in 1998, who also reported a slight difference in the biochemistry of a majority of the isolates tested compared to those considered typical of this biovar[52]. In addition, a distinction was made between symptoms of bacterial wilt on plants in the south and west districts compared with

those in the east and north. In the south and west, isolated plants are found with the disease, which does not spread[53].

Soft rot: *Pythium* attacks young plant parts, the buds on the rhizomes, the sprouts and the smallest roots. The first sign is yellowing of the leaves, starting from below, and developing upwards. The leaves collapse and can be pulled easily from the soil.

The tender buds of the rhizomes develop 'eye' rots, and if this occurs early, the entire rhizome becomes decayed, causing a soft rot. These rots often contain grubs, and farmers may think they are the cause of the damage. The grubs come after the damage has been caused by the fungus.

Dry rot: Infection by the nematodes results in three outcomes. First, plants die early because the nematodes kill the roots.

Populations build up slowly, but late in the season, in September or October, they increase rapidly. The damage causes the leaves to turn yellow, dry up and die. The yellowing starts at the top of the leaves,

in contrast to that of *Ralstonia* bacterial wilt and *Pythium* soft rot, which is first seen on the lower leaflets. Second, the nematodes attack the rhizomes, causing sunken, scabby areas, with superficial, dry, brown rots beneath. These may cover part or the entire rhizome. The buds are severely attacked and often killed. Most infections occur on the under surface of the rhizomes. Infection of the rhizomes this way reduces market price.

Third, the nematode allows the entry of other organisms, *Fusarium* especially. When the rhizomes are stored, in soil, in a shed, or even left in the field, the fungus spreads quickly through them, and they lose water and shrivel.

Nematodes were first collected from rhizomes at Suiram in 1995 and later from several other localities. They were sent to the International Institute of Parasitology, St. Albans, UK (now CABI Bioscience, Egham, UK), and identified as *Pratylenchus coffeae*, the root-lesion nematode. This is not the first record of this nematode associated with a ginger disorder in India[54], but it is the first time that it has been found in Sikkim, where, over a large part of the south district, it attacks the roots of ginger causing yellowing and premature senescence. *Fusarium oxysporum* is invariably present in rhizomes with dry rot symptoms[55].

White grubs: The grubs of four *Holotrichia* species feed on the roots of ginger, on the

rhizomes, and also on the base of the stems. Above ground, the plants turn pale yellow and the leaves can be easily pulled from the soil. The base of the leaves (the 'stems') shows that they have been chewed. Plants may be stunted. The extent of the damage to the rhizomes due to feeding by the larvae can only be seen clearly at harvest. Sometimes, rhizomes are totally destroyed.

Scientists from the University of Jaipur have found four species of white grubs in Sikkim. The common speciesin the Kitam area are *H. seticollis* and *H. sikkimensis,* with two others as yet unidentified.

Pathogenicity studies: Tests using a variety of isolates of the different pathogens were completed in 1998. As expected, isolates of *Ralstonia* and *Pythium* caused wilt and yellowing of foliage, death of tillers, rhizome soft rots, root decay and stunted plants compared to the uninfected control plants. 'Eye' rots were common on rhizomes inoculated with *Pythium*. By contrast, tests with either *Pratylenchus* or *Fusarium* produced only minor rhizome rots, although some yellowing and drying of the foliage was noticed, but when applied together, root rots were substantial[56].

5.2 Laboratory and field trials

5.2.1 Ralstonia

Studies into the control of bacterial wilt tested the benefit from planting healthy seed in land used for wetland rice. The work was done with farmers at Parchey and Lower Tarpin in the east district, and proved successful. Small plots (high beds with good drainage) were planted with healthy seed (GDTF monitored variety Bhaisey) at both sites in 1997, partly harvested in December (yield in excess of 30t/ha), and planted in formal trials in 1998, comparing the previous season's harvest with seed from another monitored source. Once more, yields were acceptable. Even though bacterial wilt occurred at Parchey in 1998, it was confined to two bays and yields were 20t/ha (1:3).

Yields at Lower Tarpin were more than twice those at Parchey (1:7), where three times the usual amount of FYM was applied at planting, and there was no bacterial wilt. In the third year, a trial was done at Parchey alone, comparing GDTF seed with farmers' seed purchased from a nearby village. Yield from the GDTF selection was much higher, but there were losses in both crops. In 2000, the family applied the technology unassisted, using the seed from the 1999 harvest. The outcome was similar to the previous year: some disease, which was contained, and acceptable yields from the remainder. The experience in 2001 was similar.

5.2.2 Pythium and Pratylenchus

5.2.2.1 Seed treatments: chemicals and hot water

These two pathogens invariably occur in the same field and, because of this, control

BACTERIAL WILT CONCLUSIONS:

- it is possible to grow ginger in land normally used for paddy in order to escape infection from bacterial wilt (the bacterium is not likely to survive in the irrigation water of the previous rice crop);
- seed must be taken from a bacterial wilt-free source; this means the crop from which the seed is taken must have been monitored for the disease;
- good drainage is essential, and water from one bay should not drain directly into the one where ginger is growing;
- hygiene is important: people should not walk in the bays where ginger is growing, in case they bring soil on their shoes from bacterial wilt-contaminated fields;
- as long as the crop is free from disease, seed can be saved for planting the following season;
- there may be a less virulent strain in the south and west districts; this needs investigation.

measures have been sought that are effective against both, and widely applicable throughout Sikkim. Trials at Kitam Farm in 1996 tested fungicides and hot water as seed treatments, with and without *mau* extraction, but the trials were devastated by white grub (even though carbofuran was applied at recommended rates at planting).

Results at Maniram in the same year, however, showed a 25 per cent increase in yield from hot water treatment, with a small, although non-significant, benefit from seed treatment with a metalaxyl/ mancozeb combination (*Metco*). Disease incidence was not affected by *mau* extraction. Trials in 1997 failed to confirm the findings[57].

In 1998, a regional trial (at Namli, Maniram, Sorok and Denchong), with three types of seed (GDTF, Farmer and Diseased), and three 'chemical' treatments (none, hot water – 51°C for 10 minutes, and hot water plus fungicide), showed: 1) at Namli and Maniram, a 40 per cent yield increase from GDTF seed over other seed sources; 2) a small (12 per cent) increase due to hot water treatment and larger increases (22 per cent) where it was used with *Metco*; 3) 'eye' rot but not dry rot symptoms were correlated with yield[58].

In a second trial, at Mangalbaria, an area with a high incidence of *Pythium*, yields were increased (44 per cent) only where GDTF seed was treated with both hot water and fungicides (*Metco*) applied as a seed dressing, and as a drench after the first germination count and again in July at earthing-up.

In 1999, results from Maniram showed again that yields were increased by about 30 per cent using GDTF seed, and that there was a slight (12 per cent) increase from hot water, which was increased further (28 per cent) when combined with mancozeb as seed treatment. There was no effect of bed height, which was incorporated as a factor in the regional trials, to improve drainage. The beneficial effects of hot water were also demonstrated at Kalimpong, West Bengal, where the incidence of *Pratylenchus* dry rot was high, but *Pythium* infection was extremely low. Here, the farmer sorted the seed into two grades, healthy and diseased[59], and treated each lot with hot water or fungicides (mancozeb/ carbendazim), with appropriate controls. Yields from diseased seed, treated with hot water, were similar to healthy seed (an increase of 66 per cent). This is an important result; it means that if farmers want to plant seed that is infected by dry rot (and many do, knowing that they will harvest early in October/November), then they should treat the seed with hot water.

Laboratory studies were done to find the optimum temperature for the destruction of nematodes on ginger seed without affecting its viability[60]. Germination of dry rot infected seed (and tiller development) was unaffected when seed was treated at 45, 48 and 51°C, for 10, 20 and 30 minutes, but delayed at 54°C and prevented at 57°C. There was some indication of reduced incidence of *Pythium* at 54 and 57°C, and, interestingly, *Fusarium* was not isolated from rhizomes treated at any temperature, although present in the non-treated control. No nematodes were extracted from seed immediately after treatment with hot water, but some were found at harvest in *mau*, new rhizomes and soil in treatments up to 51°C for 10 minutes.

An unexpected benefit from using hot water to control nematodes in the seed of ginger is that farmers have been able to extract *mau*, whereas previously the seed rotted in the ground or was of such poor quality that it could not be sold.

5.2.2.2 Etiology of dry rot

The widespread occurrence and severity of *Pratylenchus* infection in Sikkim and the fact that little research has been done on this pathogen on ginger warranted special attention to the problem. Populations of nematodes have been followed in crops of ginger, and in land where ginger was severely affected previously by dry rot (in Maniram and Denchong, Sikkim; and in Kalimpong, West Bengal). From extensive sampling carried out since 1999, *P. coffeae* was commonly present in soils taken from ginger fields, and the only species found in roots and rhizomes, except for a single occurrence of *P. pratensis* (at Denchong). Thus, *P. coffeae* is considered the main pathogen of ginger.

The occurrence of *Pratylenchus* in maize (*Zea mays*) is of special interest as the crop is widely grown in the hill states, and could be the principal alternate host, maintaining populations of the nematode between crops of ginger. To date, *P. coffeae* has not been found in roots of maize in either Sikkim or Kalimpong, although other species (*P. brachyurus, P. pratensis and P. zeae*) have been identified from this host[61]. However, *P. coffeae* has been found with *P. flakkensis* in *Commelina sp.* (*Kaney*), *Brassica campestris var. toria* (a local mustard known as *Tori*) and potato (*Solanum tuberosum*), and alone in *Phaseolus vulgaris*.

Pathogenicity tests have confirmed that *Pratylenchus* from maize is not a major pathogen of ginger and vice versa. Cross-infection from maize to ginger or ginger to maize produced low numbers in roots, compared to those recorded when the same hosts were inoculated. However, examination of samples at harvest by CABI found *P. coffeae* in maize and *P. zeae* in ginger. This suggests that the inoculum from maize and ginger contained more than one species, and provides circumstantial evidence of low-level infection of ginger by *P. zeae*, and maize by *P. coffeae*.

Pratylenchus populations in roots and rhizomes of ginger and in soil, in Sikkim and Kalimpong, monitored during the crop season, showed that numbers were low until about October when populations rose sharply (Fig. 3)[62]. When populations were monitored in soil over several years at Kalimpong, after a severe infestation in ginger in 1998, numbers of *Pratylenchus spp*. fell rapidly, but low numbers (c.20/ 250 g soil) were found throughout the intervening years (Fig. 4). Presumably the nematodes were maintained in other crops

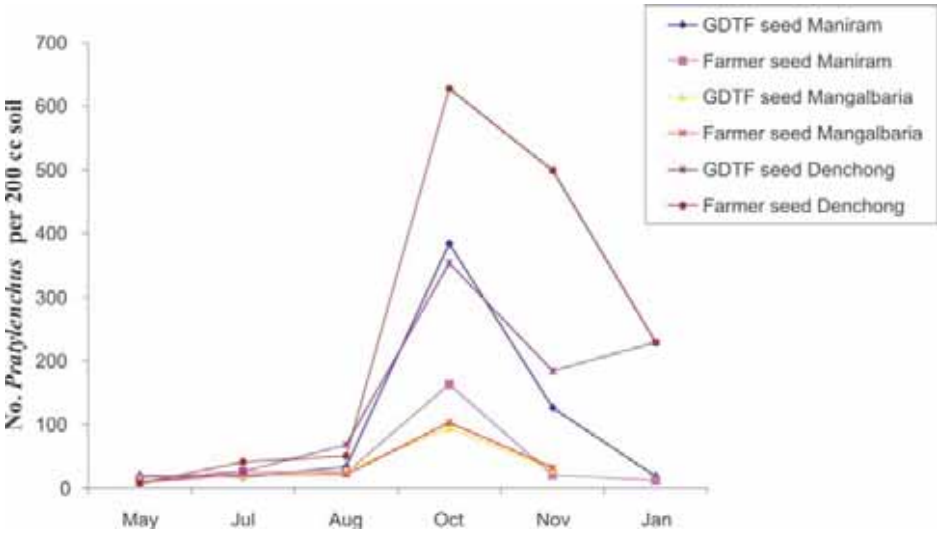

Fig. 3. *Pratylenchus* soil populations under ginger at Mangalbaria, Maniram & Denchong, 1999/2000

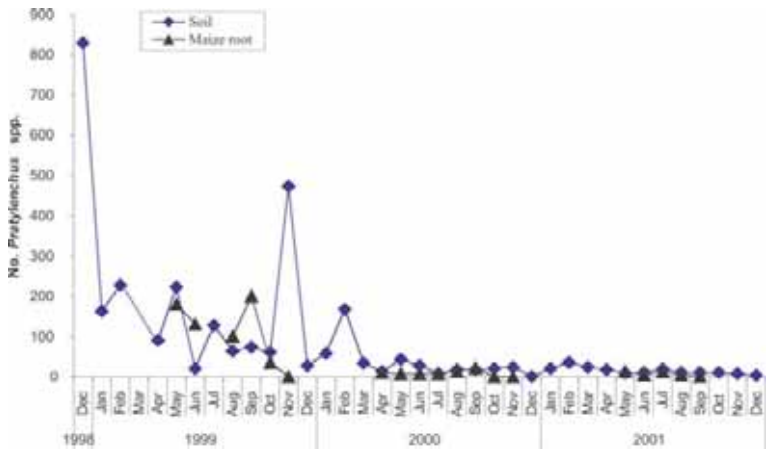

Fig. 4. *Pratylenchus* spp. recorded from soil (250cc) and maize roots (10g) at Mahakaldara, Kalimpong, West Bengal, from December 1998 till December 2001, following a heavy infestation of *P. coffeae* in ginger in 1998

grown in the rotation (eg maize; rice bean (*Vigna unbellata*); soya bean (*Glycine max*); potato; as well as weeds)[63]. However, the species of *Pratylenchus* present were tested at Maniram and Mangalbaria in 1999.

In situations where crops are infected by *Pratylenchus* and harvests are delayed (as at Denchong in 1998/99, when the trial was harvested in January), subsequent damage from *Fusarium* can be severe. Rhizomes shrivel either in the field or when harvested and stored in a pit or in a shed. Farmers associate the early drying of foliage with disease, and invariably harvest the crop and sell the rhizomes in October/ November, knowing that to delay will result in severe loss.

Although the most common nematodes associated with ginger are *Pratylenchus* species, and the ectoparasitic nematode, *Helicotylenchus*, high populations (in excess of 1500/250 g soil) of *Rotylenchulus reniformis* have also been found in Polsor village near Kalimpong. Nothing is known about this nematode on ginger.

5.2.2.3 Biological control of Pythium soft rot

Numerous isolates of *Trichoderma* have been tested against the pathogens of ginger that cause rhizome rots[64,65,66]. After screening in laboratory and pot trials, two isolates, designated T1 and M1, were tested at Maniram and Mangalbaria in 1999. They were applied to seed as slurries of fungus and cow dung, before or immediately after planting, and again at the time of earthing-up after mau extraction. Comparisons were made with seed treatments using mancozeb alone and in combination with carbendazim. None of the treatments prevented *Pythium* attack. Further trials at Mangalbaria and Bermiok in 2000, with isolate T24, were unsuccessful, as were those at ICAR using other *Trichoderma* isolates and several bacteria[67].

The isolates were re-tested at Bermiok Farm in 2001, but none showed any effective control of soft rot.

5.2.3 White grub

Research into the control of white grub compared chlorpyrifos (and quinalphos) with *Metarrhizium anisopliae*, a fungus that

SOFT AND DRY ROT CONCLUSIONS:

- there is overwhelming evidence that good quality seed is the most important factor in the control of soft and dry rots;
- in areas where dry rot is a problem and good quality seed unavailable, seed should be treated with hot water, but hot water treatments are not effective against soft rot;
- *Pratylenchus* populations are maintained in the soil between crops of ginger on a number of hosts, including other crops and weeds;
- a direct correlation was found between incidence of soft rot and yield, and that the disease is difficult to control even with good quality seed and seed treatments (additional drenches of *Metco* were needed, making control prohibitively expensive);
- the fungus, *Trichoderm*a, has not yet been shown to be an effective method of control of rhizome soft rots in the field, although its potential can be demonstrated in pot trials.

induces a lethal disease in larvae and adult beetles. The University of Jaipur provided the fungus, and entomologists from the Spices Board, Gangtok, helped with the design and implementation of trials to test its efficacy. The trials, first at Bikmat and later near Namchi, have shown no positive effect from the use of *Metarrhizium*[68].

A second approach has been to collect and destroy the adults after emergence, as they settle on *Ficus*, and other trees, to feed and mate. Collections at Kitam and Bikmat in 1997 yielded approximately 12,500 and 22,000 beetles, respectively, and were probably responsible for reduced white grub damage on ginger in subsequent years.

Preliminary investigations have also been done to determine if a sex attractant (pheromone) operates in the species of *Holotrichia* attacking ginger in Sikkim, as found in other species in India[69]. Adult beetles have been collected, pheromone glands extracted and some preliminary tests done, but as yet the nature of the active component has not been determinied[70,71].

WHITE GRUB CONCLUSIONS:

- white grub can be controlled by a single application of chlorpyrifos, as a drench (5 ml/l) applied after the first heavy rains of the monsoon;
- so far, the fungus *Metarrhizium* has not been found effective as a biological control agent of white grub in field trials;
- preliminary studies on the presence of a pheromone have begun, and should be the focus of further research;
- community action programmes aimed at collecting adult beetles as they emerge offer a practical and cost-effective method of control, and should be pursued.

5.3 Tasks ahead

5.3.1 Basic research

For the most part, practical solutions for the control of pests and diseases in Sikkim have been developed and shown to be within the reach of farmers to apply. There are, however, still some gaps in knowledge.

Ralstonia bacterial wilt: there is no reliable method of control of this pathogen in dry land. Healthy seed, high beds, good drainage, will help to reduce the incidence, but cannot be guaranteed. As the likelihood of research in Sikkim finding a solution is low, there is no point in doing it. Resources that might be available for this purpose should be put into extension technologies that have been found to be effective, concentrating on those farmers with rice paddies. Those farmers who do not have, or do not wish to use, rice bays for ginger cultivation should be encouraged to grow alternative crops.

There is need to compare the aggressive isolates from the east with those from other districts that do not spread so rapidly. If there are differences, they could affect the guidelines for the GOS Demonstration Scheme, which stipulates zero tolerance for bacterial wilt from any seed source.

Pythium soft rots: the best way to control *Pythium* soft rots is to use healthy seed. In the drier parts of Sikkim, seed dressings

with metalxyl/mancozeb or mancozeb alone, gave some benefit, but not in the wetter west, where *Pythium* incidence is high. Here, metalaxyl/mancoeb applied to the seed and as a drench to the crop, were effective, but prohibitively expensive. *Trichoderma* species were tested, but although good in pot trials they did not produce useful results in the field, and they (and endophytic bacteria) remain at the proving stage. The present recommendation is removal of diseased plants, as soon as they are seen, and apply mancozeb (2.5 g/l of product) to the 'disease' area and to the plants around. This is not based on the results of experimentation, and there is no data to support its usefulness as a control measure, although intuitive reasoning suggests that it could be effective.

The relationship of soft rot and applications of fertiliser, phosphorus in particular, is of interest. Observations in the plots of farmers taking part in the Adaptive Research Demonstrations (see 5.4) indicated that there was less disease where di-ammonium phosphate was applied. The world's literature gives little evidence for any such relationship between *Pythium* incidence and plant disease.

None of the *Pythium* isolates has been identified properly. There is an urgent need to know the species that are present, and to compare the results of work done on particular species with that recorded elsewhere in India and in other countries. Further, it is important to verify if *Phytophthora* is also present. If it is, different control measures for soft rot might be recommended.

Pratylenchus dry rot: hot water treatment of seed is effective in controlling nematode infection, although there is still a need to test whether 51°C for 10 minutes is the optimum regime (there is evidence that 51°C for 15 minutes may be superior). The problem with the technology is that it is difficult for farmers to measure the temperature accurately (and thermometers are easily broken), large containers are not easily obtained and are expensive, and firewood is often scarce. Questions also

remain about the source of nematode infection. Is it the 'residual' population in the soil or the inoculum in the seed? Further trials are needed to determine this. The answer will influence recommendations on seed treatment and crop rotation. Finally, there is a need to sort out which of the five species of *Pratylenchus* that have been found in Sikkim and Kalimpong attack ginger. In this connection, the surveys of *Pratylenchus* species in weeds and crops should continue.

White grub: the possibility that a pheromone exists in the *Holotrichia* species attacking ginger should be resolved. As a prelude to any chemical analysis, it is necessary to determine if large aggregations contain both males and females (like *Holotrichia consanguinea*), or whether mating occurs without large aggregations (like *Holotrichia reynaudi*). It is also important to know if both males and females are attracted to any pheromone compounds discovered (like *Holotrichia consanguinea*), or just males (like *Holotrichia reynaudi*). This information on aggregation and attraction is needed to assess whether a pheromone (if found) is of potential use in any integrated pest management scheme against *Holotrichia* on ginger.

For all these problems, the question is whether further efforts should be put into research, and how the various stakeholders will be involved in making this decision. If further efforts are to be put into research, this raises other questions: how will priorities be set, who is going to do it, how long will the research take, what are the costs, and how will the research be monitored.

5.4 Adaptive research demonstrations

5.4.1 Testing the research results

By the end of 1999, after 4 years' research, sufficient information was gathered and confidence created in the Department of Horticulture that it was able to begin a dialogue with farmers on the results achieved[72]. As mentioned at 4.2, this change in strategy, from trials on stations or on farmers' land to a participatory approach, coincided with a major restructure of the Department of Horticulture, large-scale staff transfers and the recruitment of new staff. Research positions were created in the district extension service allowing new technologies to be tested on horticulture farms and with farmers. To assist staff make the change in research and extension practices, the first year of the restructure saw trials with farmers in three locations (Ben Namprik, Kamrang and Sakyong). The trials were based on results from the research programme and the recommendation for ginger disease management published in an extension leaflet produced by the Department of Horticulture. The programme was known as Adaptive Research Demonstrations.

The results of the ARD programme were particularly rewarding, not least in that farmers have provided valuable information on their cultivation practices. For instance, there was general agreement among growers at Kamrang that high beds or ridges are not necessary in the dry zones[73]. They take up space, as there is a gap between beds, and the ginger often becomes exposed at maturity, making it easier for thieves to steal ginger planted this way. The ARD programme also gave useful insights into the use of fertiliser, an aspect of ginger production that has not been researched in Sikkim. It was also used to test ways of controlling dry rot, common in the relatively low rainfall areas of the south district. An experiment with farmers at Ben Namprik, in April 2000, tested different temperature/time combinations of hot water on seed heavily infected by *Pratylenchus* (see 5.2.2). Farmers found that infected seed produced healthy crops, much to their surprise[74].

In 2001, further trials by farmers began in several villages in the Bikmat area under the supervision of an NGO (Paryavaran Sangrakchan Sangh) working with village groups and local Panchayats. Farmers found that the results from using hot water against dry rot were encouraging. They reported that the roots on plants established from seed treated with hot water remained healthy up till harvest, and even seed that would have been rejected grew well and yielded marketable mau. Farmers said they realised that a solution to the dry rot problem would not come instantly. However, results from the trials gave them hope that a solution could be found eventually, as well as those of other ginger problems. The ARD approach was successful in stimulating discussions in the villages, and for the first time, farmers were finding the benefits of sharing information about ginger.

TWO FARMERS' EXPERIENCES WITH FERTILIZER

Mr Thapa of Kamrang used DAP and urea (60kg di-ammonium phosphate and 50kg urea per 16 mund as a split dose at planting and earthing-up after *mau* extraction) in his ARD trial on two rows of ginger, and left the remaining eight without fertiliser. The two rows with fertiliser yielded 86 kg, whereas only 80 kg was obtained from the rows without. The experience of another farmer from Kamrang is also worth citing. Mr Rai does not use urea, but shares other farmers' opinions that DAP gives increased yields. From 1 mund of seed he obtained 200 kg ginger (10 kg was rejected) with DAP, but without DAP the yield was only 107 kg (17 kg was rejected). DAP is subsidised by the GOS and costs Rs355 per 50 kg. If it is applied at the rate used by the farmers at Kamrang, the cost is approximately Rs35 per mund.

5.4.2 Participatory technology development

The ARD approach has been shown to be of great potential and can be adapted to any of the research needs of Sikkim. Experience

to date has shown that farmers, Panchayats and NGOs are eager for assistance, and collaboration can be established with ease. There is much to do, and efforts in 2001 have focused on three aspects. First, farmers' groups are testing hot water treatment of seed at Nandu Goan (south) and Makha (east). Second, several other farmers in the east district are evaluating the control of bacterial wilt by planting healthy seed in land normally reserved for rice. Third, in white grub outbreak areas in the south, collecting campaigns are being resuscitated, as farmers do not appear to realise their potential impact on reducing damage; this is because they are not conversant with the life cycle of the white grub. In future years, *Trichoderma* will be re-tested as a biocontrol agent against soft rot, this time applying hot water as a pre-treatment.

Carrying out a participatory technology development programme with farmers in Sikkim is possible, appropriate, and can be done in collaboration with NGOs and extension staff, albeit with training and adjustments to present methods of operation. To facilitate sustainability, PTD programmes should be undertaken preferably by NGOs, including village (self-help) groups, with Department of Horticulture staff acting as resource persons. Limitations will be encountered, however, when technical assistance is required, ie when the technologies require further research or updated advice. Efforts in the last six years have yet to establish a sustainable and credible research capacity in the State, giving rise to questions of who will conduct the further research and who will provide the updated advice.

6.1 Research concept: origins and formulation

In 1995, at the time of the studies leading up to the Ginger Disease Workshop later that year, it was apparent that there was little research on ginger in the State. However, it was considered desirable to develop the human and institutional capacity that would enable a thorough investigation to be made into the causes of the pests and diseases and some 'best bet' solutions for control to be tested. There was every hope that collaboration between the Directorate of Horticulture and ICAR, with ISPS backing, would be sufficient to establish a small laboratory specialising in ginger research, and that trials could be conducted on horticulture farms and farmers' fields. Also, it was expected that the Spices Board or CIPMC would take the lead in work on white grub research. The only concern noted at the time was that the number of staff in the national research institutes was very low[75].

The optimism for a viable collaborative research programme was further strengthened by evidence of increased importance given to the horticulture sector by the GOS. The horticulture arm of the Department of Agriculture became a Directorate in 1991 and plans to create a separate Department were under discussion. Concomitantly, budget allocations to the sector had been rising[76]. In 1994, the new structure was still being developed, but its functions had been defined. These included adaptive research on new varieties and production practices, the development of an effective extension infrastructure to disseminate results, and the distribution of improved seeds. Work on ginger was specifically mentioned as a focus of three of the GOS Demonstration Farms at Mazitar, Bermiok and Kitam.

With ICAR and the other national institutes in agreement on the seriousness of ginger pests and diseases and the need to find solutions, and with the Directorate of Horticulture resolved to develop a greater research capacity (and ISPS ready to assist), the outcome of the Ginger Disease Workshop on 12-13 September 1995 was never in doubt. In fact, the terms of reference for the consultant assisting the Workshop were explicit in what was expected[77]. They stated that:

STATE AND NATIONAL INSTITUTES COLLABORATE

The 1994 review of the institutions dealing with rural development in Sikkim (the 'Green Sector') found that cooperation between the Directorate of Horticulture, ICAR and the Spices Board was well established. The report provided examples of jointly designed and implemented long-term trials at several horticulture farms. Furthermore, the literature reviews, contacts with research personnel in India, soil and disease surveys, and PRAs to determine farmers' perceptions and cultural practices, before the 1995 Ginger Disease Workshop were all joint ventures between the Directorate of Horticulture and ICAR, and emphasised the collaboration that existed.

> … soft rot disease is a limiting factor on production and in 1995 a concerted effort began to develop control strategies …

and that:

> … as a result of the Workshop's discussion and conclusion, action plans will be developed; these will include:
>
> - The implementation of control practices appropriate to the conditions that prevail in Sikkim, particularly low input control measures (biological/ IPM);
> - The continuing evaluation of current production practices in Sikkim and the identification of the main disease constraints of producing ginger;
> - An assessment of the current on-station and on-farm research and extension programme undertaken by both the GOS and the GOI. (How can the extension methodology be improved in light of the next phase of the project where extension will be one of the main thrusts);

- ❖ The means of sourcing relevant information and the ways to up-date the research structure on such data.

  A report will be written to include the recommendations and the plan of action incorporating the above.

All that remained was to decide how to facilitate the collaboration that was desired. As mentioned at 4.1, the concept of a task force was agreed, and the GDTF created, with a remit in both research and extension. A strategic plan was also agreed specifying the objectives and activities, the timing of activities and performance measures, the responsibilities of persons and institutes, and the resources required. Details were elaborated in an annual plan during subsequent meetings with national institutes, the Directorate of Horticulture and ISPS, on 19-20 September 1995. For the most part, there was a consensus on what was required, with only two areas of contention.

The first concerned the wisdom of testing soil amendments, rotations with maize and weed control, against bacterial wilt, methods that have shown some promise on other crops attacked by the bacterium[78]. It was suggested by the workshop consultant that the opinion of overseas institutes doing similar research was required. However, the discussion at the project formulation meeting centred not on the relevance of the research, in the context of the local soil characteristics, but on whether or not the research was of interest to ICAR scientists. In the event, nothing was done on the topic and it was excluded from the work programme[79].

The second contention concerned ICAR's consideration that there should be greater research on crop rotation as a means of managing ginger pests and diseases. While an important aspect, the meeting considered that the resources for this type of work were not available to the State. A better approach might be to gather information from farmers through regional surveys in the main ginger production areas, and provision was made in the work programme for this activity.

The discussions on the technical components of the plan were considered to be in keeping with the robust dialogue common among scientists. They did not suggest any major disagreements over the plan as a whole, nor were they considered likely to affect the close collaboration between the State and the national research institutes. ICAR agreed that the Institute's plant pathologist would become a member of the GDTF, and assist with studies into the identification of the causal agents of ginger diseases as well as the field trials. Similarly, there was agreement that CIPMC would help assess the potential for white grub biological control using the fungus *Metarrhizium*[80].

As there were formal agreements in place between the State and the national research institutes, it was envisaged that they would be sufficient to accommodate the implementation of the ginger research programme without the need for additional arrangements.

6.2 Institutional strengthening

6.2.1 Establishing the GDTF

6.2.1.1 Staffing and staff development

The Ginger Disease Workshop in September 1995 nominated four members to the GDTF: a Team Leader, two senior members of the spices section of the Directorate of Horticulture and the Research Assistant (plant pathology); later, two additional members were nominated: a deputy director and a project officer (designated plant pathologist in the Office Order, although with no formal qualification). Before the Office Order was signed in January 1996, the two members of the spices section left, and a HI was recruited. Staff changes continued to be a major feature of the GDTF[81].

In order to promote involvement of the district staff in the activities of the GDTF, the Principal Director of Horticulture, in his capacity as Chairman of the GDTF, recruited Project Officers from the four districts as permanent members in December 1997.

They became the focal point for all GDTF activities in the districts and assisted in the planning of GDTF operations. At the same time, the Project Executive, ISPS, was seconded to the GDTF to assist the Team Leader, and to take responsibility for the survey of farmers' cultural practices and perceptions in 1998. These two measures were intended to strengthen the coordination of the GDTF[82].

From the outset, there was an emphasis on GDTF staff development. They attended training in the identification of microorganisms at the Indian Agriculture Research Institute, New Delhi (1996); methods for white grub control at the University of Rajasthan (1997); and visited IISR to see ginger cultivation in Kerala (1997). Training in general plant pathology was given to laboratory staff by the Long-Term Research Consultant (from April 1998 to February 2001), in nematology from an IISR expert (May 1998), and over several years by Dr Anjana Thapa (Kalimpong). The laboratory HO research assistant and the Research-in-Charge made further visits to IISR in 1999; and in the same year the laboratory HI was trained at TERI, New Delhi, in the isolation and multiplication of *vesicular-arbuscular mycorrhizae* (fungi with potential for the biological control of ginger diseases).

6.2.1.2 Coordination of activities

The Team Leader established a schedule of meetings: monthly meetings between the GDTF and the Chairman (Principal Director of the Directorate of Horticulture), and between the GDTF and ISPS. Periodically, meetings were held between the GDTF and POs in the districts, leaving the POs to brief the HIs at the district offices. Meetings were generally recorded and reports circulated to relevant staff. The Chairman of the GDTF represented the team at Joint Project Committee meetings between the Directorate of Horticulture, the Development Commissioner and ISPS.

Until 1997, the five members of the GDTF (including the ISPS Project Executive) worked as a team to accomplish the research and extension activities detailed in the annual plans. In December 1997, to improve efficiency, members were given specific responsibilities for research (including the refurbishment of the laboratory), training, seed certification and a survey of farmers' cultural practices and perceptions. Coordination of activities among members was done through weekly meetings until the Team Leader's departure in 1999.

At the end of each ginger season, after the harvest of field trials, a major review of activities was undertaken by the GDTF assisted by consultants, and an annual plan was made for the following year. Invariably, consultants assisted with the design and layout of field trials, and their visits were used to adjust programme activities as circumstances required. The annual plans fed into the ISPS YPOs, however, they were not well integrated with the annual plans of the Department of Horticulture.

6.3 Outcomes: GDTF successes and failures

6.3.1 Development of a State capacity for adaptive research

The GDTF provided a focal point for ginger research, and through its trials programme some crucial information on the etiology of ginger pathogens was obtained. But overall, it was a failure. The GDTF was unable to reach a stage where it could carry out an adaptive research programme unassisted. Also, for most of its existence it remained remote from district extension activities[83].

The concept of having a task force relied on all members coming together to achieve a common goal; however, the initial enthusiasm was not sustained and commitment flagged as time went by. It was never used by the GOS as an expert body that could help develop policy and provide strategic direction. There are several reasons for this.

6.3.1.1 Institutional arrangements

The GDTF was set up as a special unit within the (then) Directorate of Horticulture to tackle ginger diseases. As such, it needed to be appropriately constituted so that it could become the acknowledged body within the State on ginger production. In the event, the Office Order simply listed the members, and said nothing about GDTF responsibilities and method of operation. In 1997, the need for the GDTF to have procedural guidelines was discussed, but they were not developed. Duty statements for individual members were written and agreed, but were never used as guidelines for operation and review[84].

There was also a lack of any description of the relationship between the national institutes and the Department of Horticulture, the GDTF in particular. With hindsight, it can be seen that the desire to begin implementation of the programme after the Ginger Disease Workshop undermined consideration of how the various institutions (State and national) were to work together. At the very least, there was a need to define the roles and responsibilities of all the institutions and organisations involved in the programme[85]. Memoranda of understanding exist between the GOS and national institutes, as well as with ISPS, so an exchange of letters was all that was needed to describe the collaboration that was required.

If collaboration between the GDTF, the national institutes and the district extension service was weak, so was its relationship to areas within the Department of Horticulture concerned with ginger development. This was so, even though the GDTF was within a section dealing with commercial crops (cardamom, ginger, etc) and State and CSS programmes, all of which were under the same joint director (and who was GDTF Team Leader). The GDTF operated in a vacuum, and it was excluded from the activities of the CSS[86]. It was as if it was irrelevant to the CSS that underpinned the ginger programme of the Department of Horticulture; the CSS continued on its course regardless of the results from GDTF activities[87]. Little use was made of GDTF research findings and opinions, it remained mostly outside the Department of Horticulture's structure, and its work was never mainstreamed.

6.3.1.2 Management of the GDTF

It was expected that GDTF members would have been able to carry out the work programme largely unsupervised, with the Team Leader (a joint director with many other duties) delegating responsibilities accompanied by regular reviews of progress. However, GDTF members required more supervision than initially envisaged, a problem that was exacerbated by frequent staff changes. Also, the Chair of the GDTF (a principal director, and also a person with a busy schedule) was not kept informed of difficulties as they arose. In the absence of internal monitoring, and review systems within the Department Horticulture to assess GDTF progress, it was left to ISPS to mention that staff performance and the GDTF relationship to the district extension service needed to be improved, and to suggest solutions[88].

The difficulties experienced by the GDTF in the implementation of the annual plans were viewed as weaknesses that could be solved only by increasing technical and administrative assistance. A senior national scientist was recruited as a local consultant in 1996, and, thereafter, made biennial visits; and the Project Executive of ISPS became a member of the GDTF in December 1997, along with the district POs. These changes were made to get the work done, but might be questioned in the context of the prevailing culture:

- ❖ They did not help to develop a local capability to undertake research and extension programmes[89].
- ❖ They did not build confidence in the GDTF in its own ability.
- ❖ The GDTF members felt they were under scrutiny by people who had direct access to senior staff of the Department of Horticulture and ISPS.

- ❖ The initiatives were not welcomed by GDTF members, with the result that they were less inclined to carry out their responsibilities[90].

The problems of poor management were exacerbated by the lack of a budget. When funds were urgently required for repair of the GDTF vehicle, for instance, none was available. Then, when repairs were made (by ISPS), there were no funds for new tyres. This resulted in the vehicle being unavailable during critical periods. The efficiency of the GDTF was also hampered by the length of time it took to make decisions on critical issues. When staff left, their positions were not filled quickly. Protracted delays in deciding where the laboratory was to be located meant that it was three years before it became operational. The difficulties encountered in establishing the laboratory are worth stating as they epitomise the problems of the GDTF.

6.3.1.3 The GDTF laboratory

The development of a laboratory was critical to the operation of the GDTF, but as mentioned above, it was three years before it became operational. Originally, it was decided that the GDTF would share the IPM laboratory when it was built. In the interim, it would make use of the tissue culture laboratory at Tadong. However, with the restructure of the Department of Horticulture, the IPM laboratory became a facility of the Department of Agriculture, and it became clear that it was no longer available to the GDTF. In 1997, a decision was made to renovate the tissue culture laboratory, but permission to do so took several months.

While the renovations were taking place, ICAR agreed to host the GDTF Research-in-Charge, so that crucial activities (particularly pathogenicity tests) were not delayed further. ICAR was not able to commit a plant pathologist to the problems on a full-time basis, as the Institute had other responsibilities, but agreed it would help as much as possible. Funds were made available to ICAR for equipment and supplies to support the GDTF programme.

The conversion of the tissue culture laboratory into a facility for plant pathology was completed in May 1998[91]. There was an equally long delay in obtaining suitable laboratory equipment. The first supplier delivered stock of inferior quality, and finding replacements and sorting out the disputed items took time. Even in December 1997, assessments of progress were still reporting that essential items were not working properly. Either equipment arrived in need of repair, or faults developed soon after; either way, many months lapsed before the equipment was functional.

Hosting the Research-in-Charge at ICAR did not accelerate activities. The Research-in-Charge lived at Ranipool, 15 km from Gangtok. Travel to Gangtok was difficult and his level in the establishment precluded Government accommodation near the ICAR complex. The problem was not solved until late 1997 when daily transportation was provided. However, the Research-in-Charge was promoted in 1998, and took over the State IPM laboratory.

The delays in converting the tissue culture laboratory prevented pathogenicity tests from being done. Several attempts were made, but failed; and it was not until the end of 1998 that they were done satisfactorily by the Long-Term Research Consultant.

6.3.1.4 GDTF staff performance

GDTF staff found it difficult to meet the demands of a task force, which was established to solve specific problems on ginger pests and diseases, and to provide better advice to the district extension service. Management was not as effective as had been expected, and collective responsibility for providing strategic direction for the programme failed to emerge. External consultants mostly developed annual plans[92], and consequently, ownership of the programme failed to develop within the Department of Horticulture.

At the time of establishing the GDTF, it was assumed that the capacity existed within the group to organise a research programme, or at least follow detailed instructions on pathogenicity tests, trial procedures, etc. It was also assumed that officers would be able to understand the nature of the pests and diseases and, with assistance from colleagues in the districts, organise training programmes for HIs, HOs and farmers. These assumptions were not borne out by experience. Members of the Task Force had little or no background in agriculture research and extension methodologies and were not able to conceptualise what was required of them, even after extensive training. Absenteeism was common, and accepted without question of its impact on the programme.

A lack of ability on the part of the members could have been overcome if there had been keenness, team spirit and motivation; sadly, all were missing. Too often, the work was held back because of problems relating to personal advancement in the service, members being separated from their families, or dissatisfaction with the tasks assigned within the GDTF. Every effort was made to accommodate the concerns of GDTF members, helping them with promotions, housing, transport, and to improve their expertise through training, but to little avail. There was one problem after another, and combined with a high staff turnover, the development of an efficient and effective team was seriously impaired and the continuity of the programme was put in jeopardy.

Members of the GDTF, rightly or wrongly, felt that they had a heavy workload compared to other members of the Department of Horticulture and were getting little or no recognition or reward for their efforts[93]. They were expected to report for work regularly and in a timely fashion; to have duty statements that detailed their jobs; to work solely on GDTF matters; and to report on their work periodically to ensure that it was of an acceptable standard. The GDTF programme involved planning, implementation with the assistance of consultants and regular monitoring to ensure that plans were being followed. These demands were different from those applied to other staff of the Department of Horticulture, and the GDTF members fell short of expectation[94].

6.4 In search of solutions

By the end of 1997, after two years of effort, it seemed unlikely that a research capability for ginger pests and diseases could be established in Sikkim. ICAR was no longer taking part in GDTF activities, and the GDTF did not appear to have the potential to do the work unassisted. This being the case, a major shift in policy was required. Instead of developing a local research capacity, research would be 'brought in'. IISR would nominate a post-doctoral fellow, a pecialist in soil-borne diseases who would be hired for sufficient time to 'get the job done' – to get the laboratory finished, the pathogenicity tests done and the field trials properly monitored. The GDTF would focus on the healthy seed programme, which would involve training district staff in disease diagnosis, so that they in turn could help seed-source farmers improve the quality of planting material being distributed under the CSS for ginger[95]. In the long term, a seed certification scheme was envisaged, but not until the laboratory was established and the field staff were able to diagnose the common pests and diseases of ginger. To assist the GOS Demonstration Scheme and the field trials, two laboratory technicians were recruited (in 1997 and 1998 respectively), and a Long-Term Research Consultant was hired in April 1998 to train them and to take responsibility for the research work.

6.4.1 Change of approach

The recruitment of the Long-Term Research Consultant and the two laboratory technicians resulted in the achievement of the expected outcomes: the laboratory was completed, pathogenicity tests were carried out and field trials were monitored. It also enabled the start of a programme of basic

research work into biological control of soft rot diseases, *Pythium* in particular.

Although the changes put in place in 1998 were necessary to obtain urgently needed information on ginger pests and diseases and their control, they precluded sustainability. Consultants directed and mostly carried out the research, with only modest inputs from the Department of Horticulture. The lack of GDTF members to liaise with district extension services created a void, and ISPS moved to fill the gap. In 1998/99, a survey of farmers' perceptions and cultural practices was organised by the ISPS Project Executive and carried out with district staff; during the same period, ISPS recruited an external consultant to train HIs and HOs; and, in 1999, an illustrated leaflet on ginger diseases and their control was produced by ISPS and district staff, with help from the Extension Education Institute, Hyderabad.

To overcome the lack of research capability, a Department of Horticulture restructure in 1999 saw the creation of district research and development positions (DDs R&D). The idea was to integrate research into the district extension service, with trials carried out at horticulture farms. As the deputy directors (formerly POs) had little research experience, this presented a considerable challenge. However, the restructure, coming at the beginning of ISPS Phase II with its focus on active promotion of district involvement in the ginger programme, offered a unique opportunity to capitalise on the results of the first phase. In particular, it helped promote a programme of participatory technology development (through ARDs), in which district staff and farmers shared information and worked together to test best-bet practices for the control of ginger pests and diseases. In the process, and with ISPS help, district staff were trained in research as well as participatory methods of extension.

In addition to the changes in research strategies, there were changes to the GOS Demonstration Scheme, under the supervision of DDs (Extension and Training), and the operation of the CSS that provides funding for seed. Senior district staff became involved in setting tasks and responsibilities for the laboratory in order to improve its analytical capability.

Although the changes resulted in operational and institutional improvements to the district extension services, there was still a lack of research capability in the State and this was the cause for continued concern. Research was still largely the responsibility of external consultants, more so since the Long-Term Research Consultant left in February 2001. This did not bode well for the future as the GOS Demonstration Scheme and PTD programme operated without local technical support.

6.4.2 Renewed efforts to build a research capacity

Discussions between ICAR and the Department of Horticulture to renew collaboration in research into ginger pests and diseases began in February 2001. The move was precipitated by the imminent departure of the Long-Term Research Consultant, and the need to continue research into biological control of rhizome diseases, especially *Pythium* soft rot. The Acting Joint Director ICAR Gangtok agreed in principle to assist the biocontrol

THE END OF THE GDTF

By mid 1998, most full-time members of the GDTF had left, leaving only the Team Leader, a training officer and the Research-in-Charge. The latter became head of the IPM laboratory that year, and although nominally in charge of GDTF research, delegated responsibility to the Long-Term Research Consultant. Involvement of ICAR declined after 1997 (there were internal problems), and ceased with the promotion of the plant pathologist to acting joint director in 1999, and was not resuscitated until the recruitment of a replacement plant pathologist in early 2000. The GDTF was finally abandoned in 1999, with the transfer of the remaining members to other duties. This coincided with a restructure of the Department.

programme. However, the heavy work programme of the ICAR plant pathologist, which also included biocontrol of *Pythium*, precluded involvement in the research undertaken by the Department of Horticulture and ISPS[96].

There were further attempts to develop collaboration in August 2001. The Chief Secretary GOS convened a meeting of national research institutes, Department of Horticulture and ISPS. After a review of the research on ginger done by the State and national organisations (ICAR, CIPMC, Spices Board and DOH/ISPS), the meeting concluded that the amount of work done was substantial, but the lack of coordination and collaboration could result in duplication, and a waste of resources. To avoid this, regular reviews were recommended as well as monitoring. It was suggested that an Agriculture and Horticulture Research Committee be established, chaired by the Chief Secretary. This is yet to occur.

AGRICULTURE AND HORTICULTURE RESEARCH COMMITTEE

Initially, the Committee would concentrate on ginger; later, and according to need, it might broaden its mandate to other crops of importance to the farming community. Priorities for research might be biological control of *Pythium* and white grub management with pheromones. Backstopping by IISR would continue. It was envisaged the Committee would look towards ISPS to bring all parties together and to provide funds to build the capacities required. The first priority was for the Committee to be properly constituted, with terms of reference, and operational guidelines agreed by all members, and endorsed by the Chief Secretary. In addition, and before annual work programmes were set, the Committee would visit each district to see work being done by the DOH, national research institutes, NGOs and farmers.

In addition to finding ways of building new relationships between GOS and national research institutes, the August 2001 meeting also discussed the need for collaboration between the State departments dealing with plant protection. The Department of Agriculture operates the IPM laboratory dealing mainly with pests of rice, and the Department of Horticulture maintains the Ginger Disease Laboratory. To a great extent these laboratories work independently, serving their respective institutions, although the Department of Agriculture has managerial responsibility of both through the Research-in-Charge. Each has only a few staff, and this leads to problems of continuity and sustainability of the work.

A possible solution is the amalgamation of the laboratories with the development of a plant protection wing that serves both Agriculture and Horticulture, combining plant pathology and entomology[97]. This would complement the move towards coordinated activities among the national research institutes, and also improve services to the district healthy seed and PTD programmes. Furthermore, it would provide improved job opportunities for staff within a larger, merged branch, and perhaps greater work satisfaction from gaining skills in different disciplines. In addition to the present functions of the laboratories, a merged facility should include information and library services (with Internet access) as core functions.

6.5 Message propagation: experiences in extension

6.5.1 Extension and the GDTF: Phase I

The original concept was to train the GDTF in communication theory and new ways of managing pests and diseases of ginger once these were formulated from research studies. Once trained, GDTF members would train extension staff. An important part of the strategy was to create awareness in the districts that new approaches to extension were needed. Changes were required to create a more participatory approach, combining research, extension and the expertise of farmers (later referred to as ARD – Adaptive Research Demonstration), as well as the need to improve the CSS for ginger, to stop the spread of diseases on

seed distributed to farmers. The latter was particularly important, as the CSS for ginger is a significant part of the Department of Horticulture's annual work programme. The CSS involves a majority of district staff, several thousand farmers and, consequently, utilises a considerable amount of resources.

At the beginning of the project, training was carried out in large groups by extension staff who had little idea of the pests and diseases of ginger or appropriate control measures. Farmers were "instructed" to carry out the recommendations of the national research institutes, but these had never been tested in farmers' fields, and were for the most part irrelevant to their needs. The training did not encourage dialogue with farmers: the staff knew very little about the pests and diseases and felt disadvantaged as farmers often knew more. If control measures were not working, this was the farmers' fault, as they were not applying them properly[98]. However, the national research institutes did not necessarily hold this view, acknowledging the need to move towards more participatory approaches[99]. ICAR had adopted a model village concept; CIPMC, farmer field schools; and GB Pant, model families; although it was realised that for some of these new interventions, creating widespread impact would present considerable challenges.

With the formation of the GDTF in 1996, one of the first tasks was to raise the profile of the Directorate of Horticulture as a source of reliable information on ginger and pests and diseases, in particular. A leaflet for extension staff and farmers was written in English and Nepali, summarising the state of knowledge, and distributed widely. At the same time, regular radio broadcasts were made on ginger and factors limiting its production.

Another task was to form a train-the-trainers unit within the Directorate, bringing together GDTF and senior district staff who could explore new approaches to extension. In 1997, NAARM consultants were engaged to conduct a course on communication methodology for 14 POs/HOs at the State Institute of Rural Development, with technical input on ginger pests and diseases provided by IISR. The following year, the GDTF training officer assisted a consultant from Chennai in a similar course for 22 HIs at Namchi. Both these courses were successful. They introduced staff to adult learning theories, training techniques, the dynamics of group interactions, the development and presentation of training materials as well as ways of identifying pests and diseases. They showed extension staff that careful planning of farmer training is required, based on a sound understanding of ginger and factors limiting its production.

As a result of the training, staff became more confident when training farmers. HIs could identify ginger diseases with a degree of certainty, and they could discuss pests, diseases, their biology and control with growers, something that was previously impossible. In 1998, as a consequence of the training, a systematic approach was adopted: extension messages were identified by GDTF, POs and research personnel; training aids were developed; POs met to organise farmer training to be conducted by HIs throughout the State; training budgets were allocated to individual HIs; and methods of monitoring and evaluation of farmer training courses were devised.

Later, in October 1998, some of the HIs trained at Namchi in July had the opportunity to put into practice their new learned skills - they were to conduct training on the harvesting and storage of ginger for groups of 15 farmers in each of 18 villages. Although the extension staff were generally pleased with the results of the training, the exercise exposed the lack of objective assessment and reporting that is common within the Department of Horticulture. None of the HIs provided reports, and the farmers were not requested to evaluate the training they had received. A similar programme was planned for 1999.

Beneficiaries under the CSS were to be selected (again, 15 per HI) for training at key times of the crop cycle. However, funds were not forthcoming, and most HIs were not able to comply. By the end of 1999, many had been transferred to other duties and, since then, farmer training has been confined to brief sessions with beneficiaries under the CSS at the time of seed distribution.

6.5.2 Changed concepts: Phase II

The move to a greater emphasis on extension was an objective of ISPS Phase II. It was expected that the GDTF would evolve from an implementing into a coordinating and monitoring unit within the Department of Horticulture. Next to quality seed promotion, extension would become the focus of GDTF activity, working in collaboration with district staff. To improve interaction between the Department of Horticulture and producers, ginger growers' groups were to be encouraged in the main ginger growing areas.

The dissolution of the GDTF in 1999, wide-scale staff transfers the same year, coupled with a restructuring of the district extension service, disrupted the ginger programme considerably and a thorough re-assessment of the Phase II objectives was required. Although the number of HIs in the districts was increased to 60, about half were new to horticulture and knew little about ginger and its pests and diseases. This was true, too, of some staff transferred to the newly created positions of DD (E&T) and SDHO.

In order to have a complement of well-trained staff within the Department of Horticulture and at the same time to comply with the overall objectives of Phase II, a dual approach was followed. The Department took responsibility for staff training, while staff of ISPS tested participatory extension approaches, working with district staff, farmers and village-based organisations to assess farmers' experiences and test information gained from recent research.

6.5.2.1 Staff training

With the demise of the GDTF, there was no longer a unit within the Department of Horticulture to coordinate training activities. To overcome this deficiency, decentralised train-the-trainer teams were formed, comprising DDs and SDHOs in each district. These teams would train HIs and Field Men, and monitor the training of farmers by junior staff. In order to provide a framework for the training, priority was given to the needs of the CSS for ginger (the GOS Demonstration Scheme). Activities for this are defined annually, recorded in the Working Document[100], and included in the YPO. It was agreed that DDs E&T would take the lead, providing training in extension methodology, supported by technical inputs by DDs R&D. Field Men would be given prominence, as their role in the CSS had been underestimated previously: they were often given the task of monitoring seed source growers and beneficiaries, but received little formal training to do so.

Despite the good intentions, funds to carry out the training programme were not allocated under the YPO until 2001. In July of that year, 19 newly recruited HIs were trained in extension methodology, with an emphasis on participatory approaches, as well as technical aspects of ginger pests and diseases, at SIRD. Also, the development of train-the-trainer teams in each district has yet to be realised. This is still needed: in 2001, the number of HIs was increased further to 79, many without experience in the priority crops of the Department. In 2002, another 16 were recruited, bringing the number of HIs to 95.

In future years, funds for training will come from the CSS. The Department has recently re-apportioned funds to include training for staff as well as farmers. This is a major change and will ensure the sustainability of the training programme, as long as the subsidy continues.

6.5.2.2 Training materials

To support the staff and farmer training programme, training materials are required.

Although useful posters, charts and leaflets were produced at training courses by Department of Horticulture staff, none were retained and published for wider distribution. It was not until 2000 that a poster was produced, specifically for farmers, illustrating how diseases may be controlled through manipulation of cultural practices and judicious use of pesticides. Producing the poster was a lengthy process, as it relied on external consultants for drawings and layout, and clearly demonstrated the need within the Department of Horticulture for a media section that could produce training materials as the need arose. The duties of such a section might also extend to producing radio programmes on ginger cultivation, and other crops. Radio programmes appear to be appreciated by farmers, but they are provided on an *ad hoc* basis; and there is little or no involvement of farmers in the selection of topics or in the evaluation of the programmes.

STILL A LACK OF TRAINING MATERIALS

Training materials remain a priority need of the ginger improvement programme, as follows:

- A poster and/or leaflet to illustrate the life cycle of white grub.
- The leaflet on ginger diseases needs to be updated.
- A flip-chart for extension staff to train farmers, illustrating the diseases of ginger, biology of the pathogens, and means of control.
- A manual on training methods, including technical aspects of ginger pest and disease control.

The lack of a media section within the Department of Horticulture means that other ways of producing training materials need to be explored. For instance, there have been discussions between ISPS and teachers belonging to a newly formed association in Gangtok, to produce a leaflet on white grub. One suggestion is to organise a competition among schools in areas affected by white grubs. Prizes would be awarded for the best poster or leaflet illustrating the life cycle of the insect and control by community collection campaigns. Assistance could be provided by either the Spices Board or IPM staff on technical aspects of the white grub life cycle.

6.5.3 Towards participatory approaches

In Phase I, the priority was to help extension staff understand the nature of ginger diseases and how to communicate effectively with farmers. These were important initiatives, but in themselves were unlikely to bring sustainable changes within the farming communities. The overall approach was still very much determined by the Department of Horticulture in terms of what information was given, who should receive it, and when and where it was to be provided. In addition, the training was not placed within the context of the local farming systems. Concentration on a single crop may well fall short of farmers' needs, concerned as they are with complex production systems, and livelihoods that deal simultaneously with several kinds of animals and crops. Overall, farmers had little or no say in a process of knowledge generation that was supposed to be for their benefit.

There was also a concern within the Department of Horticulture that its efforts were concentrated mostly towards so-called 'progressive' farmers, or at most 25 per cent of growers. The others were supposed to have little interest in what extension staff had to offer. Illiteracy and lack of interest and commitment on the part of these farmers were listed as constraints to improvement by extension staff attending the Trainers' Training Programme with NAARM experts (23 June-5 July 1997). However, leaving out these farmers exposed an anomaly in the Department's strategy: some 5,000 'less progressive' farmers are beneficiaries each year under the CSS for ginger, and if they are not a focus for training, it is likely that ginger diseases will continue to go unchecked. They are unlikely to benefit from the

spread of ideas from the more able farmers in the community: ways of communicating with them directly and providing information in a form they might find useful were required urgently - to a large extent, this has determined extension policy in ISPS Phase II.

PTD REQUIRES A TRIPARTITE APPROACH: NGOS/CBOS ARE IMPORTANT!

Notwithstanding the absence of technical backstopping, senior staff in the East district decided to test the ARD concept in 2001. They worked with farmers on the control of bacterial wilt, using healthy seed grown in land previously reserved for irrigated rice. Every effort was made to obtain good quality seed, and junior staff worked hard with farmers in selecting plots and providing information. Unfortunately, there was no monitoring of the crops, collection of disease or harvest data, or meetings with farmers to find out what they thought of the technology. The district staff could not take on the extra demands: another level of support was needed. The need is to have NGOs/CBOs to link farmers with extension services.

As a consequence of discussions within the Department of Horticulture, new relationships are being created between research, extension and farmers, and new roles are being defined. The new strategy will widen the scope of the extension service to ensure that it allocates resources to all farmers in rural communities, irrespective of their economic status, social class, caste, religion or gender. It will focus on groups rather than individuals, take account of the inter-disciplinary lifestyle of rural peoples and facilitate farmers' decision-making and planning capabilities, supplying technical information and training inputs to meet their identified needs. Rural people will be viewed as rational decision-makers who require good information on costs as well as benefits, disadvantages as well as advantages of any new practice or procedure. Extension staff and NGOs will be trained in PRA and PTD techniques, and with farmers will take part in pilot schemes to test methodologies.

The initiation and formation of ginger grower groups in association with local community organisations and NGOs is an important step towards increasing the demand for and use of GOS extension services, and provides a platform linking research activities with farmers' knowledge.

6.5.4 Successes and limitations in extension, and the way ahead

In chapter 5, the concept of adaptive research demonstrations (5.4) was introduced. This concept is a new approach to research and extension in Sikkim, one that is based on PTD principles. The ARDs have been particularly useful in testing research findings with farmers, the original purpose. However, the Department of Horticulture and ISPS are exploring the potential of this approach as a way of disseminating information to the rural community. This is to be the thrust of ISPS Phase III[101].

It was apparent from the outset that if the ARDs were to fulfil their objective of facilitating farmer-led experimentation, then they would put a considerable strain on the resources of the Department of Horticulture. Few staff in regular contact with farmers had the ability to analyse pest and disease problems of ginger as they occurred, and suggest timely solutions. Senior staff were required to give advice, but due to other pressing commitments were often not available to do so.

The pest and disease problems of ginger are complex, and a one- or two-day training course cannot cover all the situations that are likely to arise in farmers' fields. At least four root pathogens are present and there are infestations by white grubs. These pests can occur independently or together. Assigning symptoms to cause and advising on the correct remedy is not easy, even for the most experienced scientists, let alone extension staff with minimal training. As a consequence, there have been instances of incorrect diagnosis followed by the wrong choice of chemical and dosage. This

underlines the need for technical backstopping, but this is absent in the State.

Nevertheless, the ARDs have been particularly useful in sharing ideas and concepts among farmer groups. There have been several farmer visits, some for several days: in 2001, farmers from Lower Kamrang and Sakyong travelled to the east and south districts, and farmers and extension staff from the east district discussed bacterial wilt control with the family at Parchey that first developed the technology. In these instances, the ARDs showed their potential, providing a non-competitive and non-threatening framework for information sharing from farmer to farmer, and in the power of dialogue between extension staff and farmers in generating enthusiasm for farmer experimentation and mutual learning.

The need remained, however, for scientists to be present who could provide technical information. While the ARDs in their present form can be used to test technologies with a limited number of farmers, they are not suitable as a model for agriculture extension throughout the State. The ARDs showed that the Department of Horticulture is not adequately resourced to work directly with farmers. In this context, a third, intermediary level, can provide complementary capacity: the Department can supplement the work of extension staff by entering into collaborative arrangements with non-government or community-based organisations.

There is no doubt that Department of Horticulture staff need to be made aware of the potential of PTD, and how it operates. In this connection, a series of workshops and training, such as the Participatory Training Workshop with Farmers, held at SIRD in July 2001, can be beneficial[102]. There is also a need to determine how training materials can be developed to support the new role of district extension as a service provider. Importantly, are there NGOs/CBOs that can share the extension work, and if so, how can partnerships with the Department of Horticulture be formed? And what of the role of Panchayats? These questions and others will need to be explored, as the strategy for ISPS Phase III is developed.

6.5.5 Building partnerships and awareness at the village level

6.5.5.1 Roles of NGOs/CBOs

It is becoming increasingly apparent that if ARDs are to be successful, there is need for capacity building at the village level. Local organisations are required to initiate, monitor and sustain the process of technology development and dissemination. Creating this capacity will be a challenge. Numerous NGOs are registered in Sikkim, but few are involved in agriculture or have the expertise to carry out extension activities. There are, however, two in the south district (Indrakil Natya Manch, Namchi, and the Paryavran Sangrak Chan Sangh, Bikmat) that have a keen interest in developing the necessary capacity to assist farmers to improve ginger production and with other components of the farming system. Similarly, Panchayat members and village community groups invariably show considerable interest to be involved in ginger pest and disease studies, although until recently, they have not been part of the ISPS programme.

In 2001, ISPS started to work with NGOs and also Panchayats to test the potential of these community-based organisations to trial and disseminate the technologies that have been developed. The Bikmat NGO is now testing hot water treatment against dry rot – a serious problem in the area – and four of its members attended the Participatory Training Workshop with Farmers at SIRD in June 2001, organised by ISPS. A team of young, motivated, extension staff attached to the NGO could make an impact in the villages around Bikmat (in the first instance) concentrating on dry rot, soft rot and white grub collecting programmes. Preliminary results from trials carried out by the NGO have

shown that if infected seed is given hot water treatment, it prevents *mau* from rotting; this means it can be extracted in mid-season and sold, with significant economic benefits.

The potential of the second NGO is less easy to gauge, but being associated with a village theatre group, it could be used to reinforce the cultural measures stressed in the Department's extension messages.

NGOs can work with communities to test technologies that have been developed by the Department of Horticulture, and also assist in the identification of other, perhaps more important, problems that farmers are facing. For this to be done effectively, wide community consultation is important so that problems are defined accurately, priorities established, and potential solutions for testing suggested and agreed. If farmer-led experimentation following PTD concepts is to become an accepted approach, the process of implementation will be as important as the development of new technologies. There will be need to bring all parties together in a working relationship: farmers, NGOs/ CBOs, extension staff and research scientists. Technical assistance will be required in the evaluation of potential solutions – and this is where ICAR and/or IISR can play a part. Communities need to know who to approach for information and potential solutions to their problems now and in the future. And farmers must be allowed to design, implement, monitor and evaluate the trials.

6.5.5.2 Roles of Panchayats

In villages where NGOs do not exist, Panchayats can play a significant role in organising communities (eg at Nandu Goan and Makha) to test technologies for ginger pest and disease control (eg hot water treatment). Where they do exist, Panchayats can collaborate with NGOs (eg in Bikmat) in mobilising communities (eg hot water treatment and adult white grub collecting campaigns). In addition, Panchayats either alone or together with NGOs, can take part in training programmes[103], learning skills essential for initiating group or collective action programmes in their communities.

There may be other advantages in exploring ways of providing assistance to Panchayats. It may help to strengthen linkages between Department of Horticulture programmes and other GOS departments, those of the Rural Development Department in particular. A new programme for assistance to rural areas started in April 1999. The *Swarnjayanti Gram Swarozgar Yojana* is funded by the GOI and implemented through RDD. It amalgamates several smaller schemes for youth, women, and other socially disadvantaged groups (eg DWCRA, TRYSEM, IRDP, NCUI). The programme is intended to develop self-help groups in the villages. Some groups have been formed and will be evaluated after six months to see how they have performed and whether the interest of villagers working collectively has been maintained. The scheme could become a major focus for the Department of Horticulture support in the future.

The Panchayat members have an active role in identifying projects, assisted by Rural Development Workers. So far, groups have been formed in all the districts and are still going through the probationary period. Later, they will identify projects, although some have already expressed an interest in ginger. For these, the Department of Horticulture will have a major role in providing advice, information and technical backstopping over a long period.

Members of many other groups may also be interested in obtaining advice and information on ginger pests and diseases, although ginger may not be their nominated crop. The village groups formed under the SGSY programme can be used to provide that information. In these cases, the groups will be part of a structure that will help provide the basis for sustainability. They are likely to meet regularly, have a president and secretary, and be in contact with Panchayats. In this way, members may be able to access information from GOS departments more easily than individual growers.

HOW THE SGSY WORKS

A group must have a minimum of 10 and a maximum of 20 members. Each member has to contribute Rs20 -100 per month to the group for 6 months. Members can borrow these funds to carry out projects agreed by the group. After 6 months, and if the group has shown that it is sustainable, members are eligible to apply for a subsidy of Rs10,000 and a bank loan of up to Rs15,000. They can nominate any activity, but banks and technical personnel from GOS line departments will evaluate the applications. After a further 1-2 years, the groups that are successful are eligible to apply for a Rs1.25 lakh subsidy under the scheme, and a loan of the same amount from private banks. Before dispensing the loans, training is given in technical aspects of the nominated activity as well as in financial matters. In some districts, meetings of the banks and technical departments have defined area-specific activities based on past experiences.

6.5.6 Information and communication technologies: the potential for Sikkim

Work on ginger pests and diseases is taking place in other states of India and also in other countries. Contacts with scientists in Nepal show that they are investigating seed storage and also rhizome rot diseases. If work is being done elsewhere and present experience shows that getting it done in Sikkim is problematical, obvious questions arise: Is it practical and sustainable to try to establish a local research capability against all odds? Would it be more realistic and less resource intensive to keep abreast of work done elsewhere and adapt the results to the local situation, perhaps trying out potential solutions with farmers in PTD programmes?

Attempts to establish a network on ginger pests were made in 2001, but it was unsuccessful. Few people responded to the invitation. The network was for people who work with or cultivate ginger in the Himalayas in India, Nepal, Bhutan, but also open to people who wished to join from other parts of India and elsewhere. The idea was for the network to provide a forum for information and advice, and where experiences on ginger pests and diseases could be shared. It was hoped that members would come from government research organisations and institutions, universities, colleges and schools, NGOs and the farming community. In other words, anyone with an interest in ginger pests who wants to let others know what they are doing and the results of their work, or who has a question to ask or advice to give. It was envisaged the network would be an online facility operated by email.

RURAL EMAIL: EXPERIENCES IN INDIA

Trials by the MS Swaminathan Research Foundation have shown how access to email and the Internet through wireless (2-way high frequency radio) and wired (public telephone) systems can make a significant impact in areas of high poverty. PRAs identified information needs and the degree to which the community would provide operational support and make use of the centres. Several so-called village information shops were established, one of which contained the hub that relayed email messages and provided an information centre with a dial-up account to the Internet. An evaluation carried out by the International Development Research Centre, Canada, was extremely positive, showing the varied use made of the service by all members of the community, including farmers. The communities sought market data and information on crops and livestock. Importantly, the trial showed that people with little technical skills could be trained to operate the centres and the public would pay for the service.

Although the overall response to the concept of a network was poor, scientists from Nepal say they are keen to collaborate in such a facility, and so too are those in West Bengal. Further attempts are needed to contact scientists in Himachal Pradesh, where research into ginger diseases has been carried out for a number of years, and in Assam, Jaipur, Meghalaya, Mizoram, etc. There are good reasons for collaboration with these places, as the overlap of agro-

ecological conditions in these areas means that the pests and diseases are likely to be similar.

Emerging communication technologies involving email and the Internet are likely to change the way that communities obtain information and advice. The great advantage of the new methods is the convenience and speed at which questions can be answered, or information and advice be obtained. There can be no doubt that immediate access to information is an important means of promoting rural development – improving food security and reducing poverty[104]. In this regard, the Department of Information Technology, Sikkim, has plans to develop Community Information Centers with Internet connection across the State.

The sustainability of electronic communication services in areas of poverty is of concern, as costs of establishment and maintenance are high. In Sikkim, however, communication infrastructure is already well advanced, and the trend towards decentralisation of the government bureaucracy through village Panchayats may provide the financial support to ensure sustainability.

7. Lessons to be learned

There are important lessons to be learned from an analysis of the experiences in collaboration on the ISPS ginger improvement programme. These relate to project formulation and its subsequent appraisal – which should act as a check on technical coherence and provide the opportunity to assess risks in order to maximise the chances of success. Projects can be defective because of erroneous assumptions at formulation, changing circumstances, or mis-stated objectives. However, ongoing monitoring and evaluation and effective and regular review during implementation should highlight the changes necessary to get the project back on track.

Prior to 1995, there was no concerted effort to provide farmers with reliable information on ginger pests and diseases so that they might improve their management skills, or to consider indigenous concepts, practices and technologies[105]. The GOS distributed seed and advocated chemical drenches of one kind or another when pests appeared. But mostly, these interventions did not work: the seed was often contaminated by pathogens, which exacerbated the spread of diseases, and pesticides were inappropriate or applied incorrectly. The Government did not have a research capability and there is no university in the State that might intervene. Some work had been done by ICAR, and there was an interest to do more. In these circumstances, the best approach was to support ICAR and other national institutes, to carry out basic research into ginger pests and diseases, and to assist develop a capacity for adaptive research in keeping with the limited resources available within the Directorate of Horticulture. This seemed sensible: the national institutes have a mandate to assist the State and have access to long-term funding. An alternative strategy was to build a self-sufficient research capability at State level, but this was not in keeping with the aim of providing immediate answers to problems confronting the ginger farmers, and *ad hoc* and inadequate resourcing might mean its sustainability would always be in doubt.

Unfortunately, assistance to the Department of Horticulture from the national institutes has been inconsistent and insufficient. There is neither a capacity for basic nor adaptive research within the State. As a means of institutional strengthening, the GDTF did not succeed, although it was hoped that it would complement the functions of the national research institutes and the district extension services, acting as a conduit for information generated locally or elsewhere in India and overseas. It had the potential to improve extension capabilities by identifying training needs; it could have made constructive inputs to the GOS Demonstration Scheme; and it could have provided useful inputs to Government plans and policy. But the GDTF did none of these.

Why was the GDTF so ineffectual; and what were the difficulties in maintaining collaboration with the national research institutes, ICAR in particular, when the willingness to collaborate was evident at the start of the project? Further analysis may shed some light on these questions.

7.1 Project formulation, design, appraisal and implementation

7.1.1 The rush to implementation

If the project had gone through a proper formulation and design phase, many of the subsequent failings might have been avoided. The usual sequence of events in a project management cycle is identification of the issue that needs to be addressed, formulation and design (including assessment of the feasibility of possible strategies and appraisal of the costs and risks of proposed options), implementation (including ongoing monitoring and regular review), and evaluation (of whether and how the stated and revised objectives were achieved, and whether there are lessons for the future, including from unintended

consequences). Some aspects were done well. The need for attention to ginger and its pests and diseases was determined during the Pre-Phase of ISPS in reviews of the 'green' sector[106]. Meetings between the Directorate of Horticulture, ICAR and ISPS, confirmed the need for research into ginger pests and diseases and a feasibility study was undertaken, with sub-committees established to look into various factors limiting production. PRAs were carried out in villages to obtain farmers' views and these corroborated the information obtained from the desk studies.

After a thorough project identification phase in 1994 and 1995, the parties agreed to move to the next stage. Terms of reference were written for a consultant to assist at the Ginger Disease Workshop in September 1995, at which there was broad representation from the departments dealing with ginger development, the national research institutes and ISPS. A strategy was agreed, including goal, objectives, outputs, and an outline of activities (the parties detailed activities, including timing and responsibility, at subsequent meetings).

In retrospect, the time allocated for formulation and design was too short. The reason for this may have been because much of the groundwork for collaboration between the parties was already in place. Consequently, the project goal and objectives were anticipated in the terms of reference for the Ginger Disease Workshop consultant. This combination of time allocated and the relationships involved, limited the opportunity for *bona fide* discussion at the Workshop. If a proper formulation and design stage had been followed, the Workshop would have been the forum where possible strategies for addressing the issue of ginger pests and diseases in the State would have been tabled and debated. A project outline, perhaps in the form of a log frame, would have been produced, including performance measures, means of verification, assumptions and pre-conditions for implementation.

WHAT WERE THE RISKS?

The Pre-Phase documents provide much evidence that any intervention to improve the ginger industry in Sikkim would be fraught with difficulties. PRAs of rural livelihood systems and a profile of the 'green' sector in 1994, point out the many deficiencies of Government departments at that time. According to these reports, there was a prevailing view that problems could be solved solely by transfer of technology (packages of solutions). Other shortcomings were: senior staff plan and junior staff implement without involvement in programme design, farming systems are not understood, subsidies are pervasive, quantitative targets abound but qualitative objectives are lacking, monitoring and review of activities are non-existent, and there is little interaction with farmers. Furthermore, research capacity is weak, and where recommendations are given, they are not presented in a form suitable to farmers. "Visions (where to be in 10 years), strategies (how to get there) and concepts (what to do) are sometimes unrealistic, unclear or simply lacking and rarely based on preceding situational analysis". Tarnutzer A (1994). *Profile of institutional actors in the green sector of Sikki*m. A joint study by Government of Sikkim and Intercooperation/ GIUZ. Study Group on Institutions, Human Action and Resource Management, Institute of Geography, University of Zurich. Page 9.

The Workshop would have listed and assessed the assumptions and risks of proposed strategies. The relative merits of the strategies would have been compared, and the feasibility of each appraised. The likely costs involved would have been confronted, including the resources required. With a project outline (or log frame) in place, the period after the Workshop could then have been used to prepare a project design document, including draft letters or other appropriate instruments describing the proposed collaboration between the Directorate of Horticulture and the national research institutes (and the support of ISPS). The project design document would have then been provided to all parties for comment, amendment, agreement and signature.

As mentioned above, a key element of the formulation and design stage would have

been assumptions, which in turn would have highlighted risks. However, the assumptions were never explicitly specified, and thus there was no opportunity for any inherent risks to be analysed when plans were discussed after the Workshop. Agricultural research is often considered a high-risk area for intervention by donors, and even in small, relatively uncomplicated programmes such as that under discussion, a risk management plan could have been an important monitoring device. It could have been developed, agreed along with annual plans, and updated at 6-monthly GDTF meetings with consultants. A risk assessment exercise would have required the involvement of all stakeholders, even though sensitive and challenging issues often need to be discussed. Other than the elimination of the element of surprise when events take an unexpected turn during implementation (because they have been anticipated and plans made to deal with them), risk analysis is a useful tool for creating transparency in decision-making and providing clarity for implementation.

Although ongoing monitoring was, for the most part, done satisfactorily using regular visits from consultants, there was need for a mid-term review at the end of the strategic plan, after three years of implementation[107]. Only an internal assessment was carried out by the GDTF, assisted by the same consultant who was involved in the original design, and who had backstopped the project during implementation[108]. The process did not guarantee impartiality! Nevertheless, problem areas were identified, including the management of the GDTF (eg the Team Leader had too many other responsibilities), delays associated with the establishment of the laboratory, staffing issues such as their attitude to their duties and high turnover, and the ambitious programme devised in 1995 compared to the resources at its disposal[109]. However, the review did not comment on the lack of assistance from national research institutes in the implementation of the programme or how this might affect sustainability. By the time of the review (in December 1998), research was under the control of IISR, without input from ICAR, Gangtok, although it was still hoped that the situation could be reversed[110].

Thus, there was no serious questioning of the project, and the course it was on, a situation that still exists today. An in-depth review is required, not just an assessment[111]. Although a case can be made that the project has evolved progressively over time and that the current situation is the result of a considered response to events, a less charitable view might be that its implementation has been characterised by a series of crises and, without a proper strategic plan or a clear sense of direction, the policy responses were *ad hoc* and not integrated with any State or national goals.

7.1.2 Institutional capacity to implement

Overall, there was insufficient attention given to the ability of the Department of Horticulture to implement the ginger programme effectively: it was assumed that staff were available that could relate to the tasks at hand, and the management structures in place to ensure monitoring and appropriate response when adjustments were required. The reality was that the staff of the GDTF did not have the qualifications and experience for the tasks and, consequently, lacked confidence and motivation. This, and a lack of day-to-day management and supervision, meant that the work, although well planned, was either not done or done poorly.

The nature of these problems was not new. They were evident in the 1994 review of the 'green' sector[112]. So it is, perhaps, not surprising that the GDTF was so ineffectual; what is surprising is that it was formed with the expectation that it would develop a different work ethic to those prevailing at the time. As the Assessment Report of Phase I put it: "The approach in ISPS programmes often is new and often runs contrary to established routines"[113]. Some of the major issues include:

Qualifications: The lack of appropriate qualifications of people appointed to positions assisting the ginger programme[114]. Compounding the problem is the lack of a proper recruitment process, with job advertisement and interview. The Department of Horticulture recruits staff, but there appear to be no public service selection criteria or standard recruitment procedures. At other times, large staff transfers occur between departments without regard to the impact that these cause[115]. Under such circumstances, it is difficult to develop viable long-term programmes, especially if these involve investment in staff training, as the benefits are ephemeral.

*Application of merit-based principle*s: In addition to the lack of a recruitment process for the selection of appropriately qualified staff and the *ad hoc* approach to staffing transfers mentioned above, officers are not promoted according to their ability, but on time served (or "political connections"). This impedes the advancement of more able and motivated staff, and impacts negatively on their contribution to the betterment of the Department of Horticulture. Career structures in research do not exist, so staff have to look elsewhere for promotion.

*Monitoring work standard*s: There are two measures for assessing satisfactory work standard: these are performance and conduct. Performance relates to the skills and ability of the staff to do the tasks required, and conduct concerns their attitude and behaviour on the job. Staff recruited to the GDTF failed to appreciate that they were expected to produce work of a consistently high standard, to attend work regularly, and to follow instructions.

*Performance appraisal*s: Staff do not have regular performance appraisals, allowing both supervisor and staff member the chance of mutual feedback, to assess key achievements against specified measures, and to identify areas for improvement. For this to happen, staff duties need to be clearly defined, and job titles should describe the work of the incumbent.

Changes to work ethics are unlikely to come fast, as attitudes resulting in poor performance are well entrenched. However, some improvement is likely if reforms such as those occurring in other departments also take place in the Department of Horticulture, and they are implemented properly. A review of the organisation's structure, operating systems and staff roles and responsibilities is urgently required. There are many young staff in the extension service that have all the attributes needed to raise standards within the Department: they are well qualified, motivated and sense that change is needed if they are to assist farmers in a meaningful way.

7.1.3 Need for integrated planning

The GDTF made annual plans, which were included in ISPS YPOs, but they were never integrated into the plans of the Department of Horticulture[116]. One reason for this is the different timing of planning cycles: the ISPS YPO is agreed in April and the Department's plans are made in October. Consequently, there was no allocation of funds for GDTF activities. Where funds were required, they were sought mostly from ISPS.

The result was that the GDTF was seen as an ISPS entity; there was no ownership by the Department of Horticulture. It also caused confusion in the districts, as it seemed that there were two entities dealing with ginger improvement – the Department and ISPS. The CSS programme continued as before, and attempts by the GDTF to influence its direction went unheeded. It was only later, after the dissolution of the GDTF, that improvements to the CSS were possible, with ISPS support now focused on extension.

7.2 Concluding remarks

The analysis of experiences in collaboration on the ginger pest and disease programme highlights the fact that although results have been achieved, the project as a whole has not lived up to expectations. Of the many shortcomings, the lack of a

sustainable research capability is a major disappointment[117]. The analysis has shown that while the need for research was well understood, and priorities were based on constraints as stakeholders perceived them, problems occurred during implementation through lack of clearly defined and well understood working relationships (and budgets) among the parties involved. Several lessons have been learned from this analysis, however, the following key messages are worth stating in closing:

*Relevanc*e: For some of the problems, the project has come up with what might appear to be realistic solutions, but these are still to be assessed by farmers. For topics still under investigation, a consensus is needed on approach. Most importantly, the potential of the biological control of soil-borne pathogens needs to be assessed. The GDTF was critical of this work, but the reason was never clear as a similar approach for white grub control was supported. ICAR considered that biological control has potential, but decided to conduct studies separately from those of the Department of Horticulture. If a biological approach is considered appropriate in terms of its impact on the environment and human health, how is its potential to be assessed? How will consensus be obtained on how the work should proceed? If this work is to go forward, it must be supported by the Department, and done in collaboration with ICAR (including IISR), but how is this to be achieved? Significantly, how will the relevance of the biological approach to farmers be assured?

*Target beneficiarie*s: Who was supposed to benefit directly from the project – farmers or institutions, national or State – and how? The project aimed in the first instance to improve human and institutional capacity (State and ICAR) in the conduct of research, so should extension have figured in formulation and design from the outset? It might have been better if the GDTF had concentrated exclusively on research in Phase I and, once information had been obtained on the pests and diseases, to have worked with the districts in Phase II[118]. As it was, GDTF efforts on research and extension were spread too thinly, and neither received the attention it deserved. The ISPS Pre-Phase should have examined the likelihood of the objectives being achieved within the prescribed project period, subject neither to complementary interventions by other institutes (such as IISR) nor to the possibility of extensions of the project period.

*Ongoing assessmen*t: There was inadequate analysis at the formulation and design stage, making monitoring and review difficult. A proper risk management plan should have been developed to guide monitoring, and an objective impact assessment undertaken after three years. As soon as it became apparent that national institutions could not, for whatever reason, give the support that was required, and the GDTF would be unable to do the work unassisted, these issues should have been confronted at the annual reviews and remedial action agreed and implemented. The opportunity to restructure ISPS assistance came late, one year after the start of Phase II, and only then because most GDTF staff were transferred to other duties and the Team Leader retired. Under the circumstances, the GDTF should have had a defined life, with a review built into its mandate from the outset. Once set up, the GDTF was difficult to disband, even when it had become redundant.

*Ownershi*p: If the stakeholders in the project were intended to be the Directorate (Department) of Horticulture and ICAR, a sense of ownership never developed. ICAR dropped out and the GDTF gave the impression that it considered the project belonged to ISPS. Furthermore, the Department's annual plan did not incorporate the activities of the GDTF, and farmers were never included in the planning process. Stakeholders need to be involved in decision-making, from identification through formulation and design, appraisal, implementation,

monitoring and review, to making adjustments and in evaluation. This involvement must be real. All parties must be satisfied that they have had an opportunity to air their views, and by seeing that some are acted on, be able to feel that their contribution is equally valued. Unilateral decisions by any of the parties should be avoided, and in instances where views are not pursued, reasons should be given. In many cases during the project, these basic principles were not followed, making it impossible for the intended stakeholders to develop a sense of ownership for the work.

Sustainability: This relates to both institutional capacity building and technology adoption by farmers. Sustainability should be a central feature of formulation and design. Institutional support should not change radically during implementation (without a review of objectives and inputs). Initially, there was a strong emphasis on building the expertise of ICAR and other national institutes. When this strategy was found wanting, more effort was placed on developing a State research capacity. This was never a viable option and research had to be 'brought in', a last minute solution done without proper consultation with the Department of Horticulture. Consequently, it soured working relationships between the GDTF and ISPS. While this may have been the only solution to getting the answers on ginger pests and diseases, it compromised any chance of sustainability.

Framework for assistance: The key message that is perhaps of greatest significance is that success in development assistance requires understanding among parties within an appropriate policy framework. The project has been a learning experience for both the Department of Horticulture and ISPS. During its six years, attitudes have changed considerably, and so too has the context of the collaboration:

- In the Pre-Phase (1993-1995), expectations were high – ISPS was the first resident, externally-funded project in the State, and there was much enthusiasm and interest. Ginger PRAs were well attended, informative and done well.
- Implementation (1996-2001) saw a new turn of events – instead of broad participation in the benefits of collaboration, they were provided to a few, and separate plans produced a lack of ownership of the ISPS initiative. GDTF staff worked under different terms and conditions, were monitored closely, and felt they lacked recognition. Even though the performance of individuals, both in the GDTF and districts, was enhanced, institutional change was minimal. The GDTF was avoided, staff turnover was high and replacements difficult to find.
- Government strategies changed (from the beginning of 2001) – there was to be "less government, reorganised departments and more stakeholder involvement", giving greater authority to the Panchayats[119]. As a result, the knowledge and skills acquired by extension staff became more useful. The importance of training received was realised in the context of the new policy environment. The project now supports the Department's work, to improve the GOS Demonstration Scheme and to pilot PTD, working with district extension staff and NGOs. This support has the potential to bring considerable benefit.

The critical message is that development assistance has to be provided in a policy framework that is relevant and meaningful to all the parties. There should be one planning process, not two, and all stakeholders need to be involved and consulted regularly, so that there is transparency in decision-making and clarity in implementation.

Notes

1 Sampang T *et al*. (1994). Rapid market appraisal of twelve Sikkim ginger, vegetable, and fruit markets. Indo-Swiss Project Sikkim/Intercooperation. Department of Agriculture, Government of Sikkim. 12 pp.
2 Crop Calender (sic) Ginger (undated). Department of Agriculture and ICAR. Government of Sikkim. Note, Pathiram *et al*. (undated). An appraisal of ginger production in Sikkim. ICAR Research Complex for North Eastern Hill Region, Sikkim, Tadong, Gangtok, records 3,410 mt from 640 ha for 1981/82.
3 Pathiram *et al*. (undated). Ibid, page 8.
4 Pathiram *et al*. (undated). Ibid, page 2 give relatively low increases in productivity from 1981/94.
5 By contrast, yields of 22.5 t/ha are given for the Mamlay watershed: Sharma E *et al*. (1992). Integrated watershed management. A case study in Sikkim Himalaya. G.B. Pant Institute of Himalayan Environment & Development. Gyanodaya Prakashan, Nainital.
6 Gurung N (1999). Ginger Diseases in Sikkim. Farmers' perception and cultural practices. Department of Horticulture and Indo-Swiss Project Sikkim.
7 The paper does not, however, record any details of the surveys: the number of farmers and villages visited, nor the districts covered.
8 There was no mention of *Pythium* in surveys carried out in 1988; in these bacterial wilt, root knot nematode and white grub were considered to be the cause of major problems (see 2.2).
9 It is possible that some compensation occurs if the remaining plants, unaffected by disease, use resources (nutrients, water, space, etc) that would otherwise have been unavailable to them had neighbouring plants remained alive. It is also difficult to estimate losses where more than one pest or disease occurs at the same time. For instance, white grub may occur with any of the diseases affecting rhizomes and roots, and if left uncontrolled can devastate the crop. In this case, *Pythium* would be of little consequence. The same is true if bacterial wilt occurred together with pests or other diseases. Such interactions are common, and need to be taken into account when estimating crop losses from insects and pathogens.
10 Rai S and Gurung A (1997). Mother rhizome extraction of ginger *(Zingiber officinale* Roscoe) – an age old practice in Sikkim and Darjeeling Hills. *Environment & Ecology* 15(4): 910-912.
11 Gurung N (1999). Op. Cit., page 7.
12 Trials by the GDTF at Sorok in 1998 found plants infected by bacterial wilt and also *Pythium* soft rot. Sorok is in a belt where nematode dry rot is also prevalent.
13 Even at Bikmat there was evidence that crop yields were declining as the ratio of seed planted to final yield had decreased in recent years from 1:6 to 1:4. Subsequent visits in 2001 found that many farmers were obtaining yields of 1:1.5 to 1:2, after *mau* extraction. *Pythium* soft rot was recognised as a disease of the wet season, with severe dry rot caused by *Pratylenchus* occurring later.
14 Gurung N (1999). Op. Cit., page 9.
15 Annually, the GOS distributes seed to approximately 5,000 growers *(*c. 1 mund each) or a quarter of the farmers growing the crop. In most instances, however, this allocation is in addition to farmers' own seed and is done to increase the area of ginger cultivation in the State.
16 Shrivastava LS (1995). Review of ginger diseases. *In*: Ginger Disease Workshop: Proceedings and Strategic Plan. 12-13 September 1995, Gangtok, Sikkim. Sydney, Australia.
17 Ray S *et al.* (1990). An epiphytotic emergence of white grub in Sikkim and its management. ICAR Research Complex for NEH Region. Newsletter 13(1): 1-2.
18 Tips for growing ginger in Sikkim (Undated). ICAR, Gangtok.

19 Shrivastava LS (1994). Management of soft rot of ginger in Sikkim. Plant Disease Research 9(2): 147-149.

20 Tarnutzer A (1994). Profile of institutional actors in the green sector of Sikkim. A joint study by Government of Sikkim and Intercooperation/GIUZ. Study Group on Institutions, Human Action and Resource Management, Institute of Geography, University of Zurich.

21 The Directorate of Horticulture became a department in 1997; until that time it was located within the Department of Agriculture.

22 Tarnutzer A (coordinator/editor) and Battig CH (co-editor) (1994). Participatory rapid appraisal (PRA) of rural livelihood systems in Sikkim with special emphasis on animal and crop husbandry. A joint study by Government of Sikkim and Intercooperation/GIUZ. Study Group on Institutions, Human Action and Resource Management, Institute of Geography, University of Zurich.

23 Shrivastava LS. Major diseases of ginger and their management - a review; Bhutia U, Basnet RK, Chettri D, Singh HC and Kurup KPP. Topical participatory rapid appraisal of ginger production practices in Sikkim; Upadhyaya RC. Ginger crop pests review; Pathiram *et al*. An appraisal of ginger production in Sikkim; and a report containing isolations from 110 samples of diseased ginger collected throughout the State compiled by Basnet CP and Gupta SR.

24 Jackson GVH (1995b). Diseases of ginger in Sikkim and their control. A synthesis paper produced for the Indo-Swiss Project Sikkim. Sydney.

25 Ibid, page 17.

26 Samples from Suiram were sent to Dr John Bridge at IIP, UK (now CABI Bioscience) and yielded large populations of the nematode, *Pratylenchus coffeae*. The presence of 'eye' rots on rhizomes with high populations of *P. coffeae*, a well-known parasitic nematode, plus the fact that yellowing and death of leaves on these plants differed from that of *Pythium* infection, was responsible for thinking that 'eye' rot was caused by *Pratylenchus* (see leaflet: Ginger diseases (1996). Directorate of Horticulture, Government of Sikkim. ISPS, Sikkim. Canberra). Later surveys and pathogenicity tests corrected the mistake.

27 The virus was first reported from Australia in importations of ginger from India, Malaysia, Mauritius and Thailand: Thomas JE (1986). *Annuals of Applied Biology* 108: 43; Thomas JE (1988). *AAB Descriptions of Plant Viruses* No. 328, 4 pp.

28 The Secretary announced at the Ginger Disease Workshop that a grant of 20 lakhs had been allocated by the GOI for an IPM complex, including buildings and equipment. Once complete, studies on ginger pests and diseases would be carried out at the complex. In the meantime, a temporary location was required, and the only one available at minimum cost of conversion was the tissue culture laboratory at Tadong.

29 It was also noted that final decisions on the research programme rest with the Scientific Research Council of ICAR at Shillong. Tarnutzer A (1994). Op. Cit., pages 6 and 37.

30 However, the 1994 survey of the green sector states "out of 25 sanctioned posts, 13 are vacant at present. Most of the 28 posts of technicians are filled at the moment". Tarnutzer A (1994). Op. Cit., page 37.

31 Tarnutzer A (1994). Op. Cit., page 38.

32 Tarnutzer A (1994). Op. Cit., page 10 states: "GOS Departments .... largely intend to keep working along the established lines ..... In this view, improvements will come about if more of the same is provided, ie systems are expanded to make farmers finally adopt what is seen as best for them".

33 Pesticides were given to farmers without explanation as to how they should be applied (amounts, frequency, etc) or the safety precautions necessary for their application.

34 In 1994, 1,300 mt of seed was made available to 5,000 growers without cost – growers contracted under Directorate supervision produced 50 mt, and 10 mt was produced on Government Farms. However, there was no monitoring to determine the success of these interventions in terms of improved quality or yield of the crops grown.

35 In 1994/95, GOS allocated Rs1.8 crores for ginger development and in 1995/96 Rs1.4 crores was expected.

36 Bachmann F *et al*. (1995). Project document for main phase I, April 1 1996 - March 1999. Submitted to the Government of Sikkim and Swiss Development Cooperation. ISPS, Gangtok. Pages 10 and 25.

37 In addition to taking part in surveys, the ICAR plant pathologist also made isolations from diseased material collected. By contrast, collaboration with the soil scientist did not occur; even offers from ISPS to repair needy equipment failed to elicit collaboration.

38 Bachman F *et al*. (1995). Op. Cit., page 24.

39 Ibid, page 24.

40 Under this project, which worked in collaboration with the All India Coordinated Research Project on White Grubs, ICAR, Jaipur, there were several visits to Sikkim by project scientists to collect and identify species of white grubs in the outbreak areas.

41 Ibid, page 3.

42 Jackson GVH and Sarma YR (1999). Ginger Disease Control. Progress Report V Phase I: Analysis of 1998 and plans for Phase II. ISPS, Gangtok.

43 Project document for Phase II of ISPS. April 1, 1999 – March 31, 2002. (1998). Report submitted to Government of Sikkim and Swiss Agency for Development and Cooperation.

44 Ibid, page 21.

45 Ibid, page 21.

46 Ibid, page 22.

47 Ibid, page 22.

48 Jackson GVH and Sarma YR (2000). Ginger Disease Control: Progress Report 2 Phase II: Restructure and Trials. ISPS, Gangtok.

49 Some farmers satisfactorily manage outbreaks of bacterial wilt by digging deep drains to prevent spread. In such cases, farmers have been included as seed source growers.

50 Members of the GDTF visited IIAR, New Delhi, for 2 weeks in March 1996 (together with the plant pathologist of ICAR, Gangtok) for training in pathogen recognition and pathogenicity testing. In the same year, the GDTF visited IISR, Calicut, to gain a better understanding of the research being carried out into diseases caused by bacterial wilt and *Pythium*, and to gain experience in nematology. In 1998, the HO laboratory research assistant went to TERI for training on VAM fungi.

51 50 villages were selected at random from the main ginger production areas, and all farmers interviewed. However, even after training, in both 1996 and 1997, the extension staff found great difficulty in identifying the diseases, estimating incidence and obtaining reliable yields, and the data were not analysed statistically. Some villages were identified with relatively low disease. The survey found that bacterial wilt was more widespread in the State than thought previously. In 1998, a year-long survey was conducted successfully after staff were trained ton three occasions to collect data during the year.

52 Kumar A (undated). Biovar differentiation of *Ralstonia solanacearum* infecting ginger in Sikkim. Indian Institute of Spices Research, Calicut, India. Eleven of the isolates were dulcitol negative.

53 Surveys throughout the west and south districts invariably report plants with bacterial wilt, but although the symptoms are the same as seen in the east and north, spread is much less. Often a single plant is affected. A similar condition reported from Australia

(and also seen in Fiji) causing a slow wilt on ginger is also due to biovar 3. In Sikkim, this is probably the same biotype that causes wilts on tomato, eggplant and pepper, and may be a different strain from that on ginger.

54 Kaur DJ and Sharma NK (1990). A new report on *Pratylenchus coffeae* - a cause of ginger yellows. International Nematology Newsletter 7(1): 15-16.

55 Rajan PP (1999). Technical report in ginger pathogenicity and disease management studies conducted as part of the GDTF programme (1998-1999). ISPS, Gangtok.

56 Ibid, page 10

57 The trials showed a 10 per cent increase in yield overall using GDTF selected seed, but seed treatments failed to show any effects, probably because the farmers selected did not have ginger disease problems the previous season.

58 The comparison was made by covariance analysis. It should be noted that whereas damage from *Pythium* can be seen as 'eye' or soft rots, and estimated directly, that from *Pratylenchus* can only be ssed indirectly through symptoms on rhizomes, but the main effect of the nematode is the destruction of the root system.

59 In effect, selecting for and against infection from *Pratylenchus*/*Fusarium*, the cause of sunken lesions and shrivelling.

60 Rajan PP (1999). Op Cit., page 28.

61 Identified from samples sent to CABI Bioscience, UK.

62 A similar rapid rise in soil populations of *Pratylenchus* in October/November was found in 1998/1999 in both the regional and biocontrol trials, presumably due to release of nematodes as root decay.

63 The following are hosts: Udasey[1], *Siegesbecleia orientalis;* kaney, *Commelina benghalensis*; Udasey[2], *Blainvellia* sp.; Elamey, *Galinsoga parviflora*; Lal sag, *Amaranthus* sp.: Tori, *Brassica campestris* var. *toria*; and marigold, *Tagetes* sp.)

64 Rajan PP (1999). Op. Cit.

65 Rajan PP (2000). Technical report on activities of GDTF laboratory during 1999-2000 crop season as part of ginger disease management programme of GDTF. ISPS, Gangtok.

66 Rajan PP (2001). Research activities of ginger disease laboratory for the year 2000-2001. ISPS, Gangtok.

67 The trial at Mangalbaria was harvested prematurely in the absence of Department staff. At Bermiok, up-welling of spring water promoted unusually conducive conditions for *Pythium* and most plants rotted (although there was an indication of lower disease and higher yields where hot water was combined with T24). At ICAR, the trials were destroyed by bacterial wilt. Some of the bacterial isolates included endophytes, isolated from within apparently healthy rhizomes. (see Jackson GVH and Sarma YR 2001. Ginger disease control. Progress report 4 phase II. ISPS, Gangtok.)

68 Studies on the control of white grub at Bikmat in 1997 were report by Varadarasan S *et a*l. (undated). Bioecology and management of white grub *Holotrichia seticollis* Mosher (Melolonthinae: Coleoptera), a major pest on ginger in Sikkim. Spices Board, Gangtok. Although the chemicals and *Metarrhizium* were shown to reduce the number of white grub larvae compared to the control, the paper does not explain why yields were extraordinarily low (approximately 500-775g/3m^2 plot, equivalent to 1.7-2.6 t/ha), and as such question the efficacy of the treatments and the conclusions drawn.

69 Ward A *et a*l. (2002). Identification of the sex pheromone of *Holotrichia reynaud*i. *Journal of Chemical Ecology* 28: 515-522. (Note that anisole is the sex pheromone of both *H. reynaudi* and *H. consanguinea*).

70 Vijayvergia JN (1999). Report on the work carried out on pheromone studies on ginger white grub *(Holotrichia seticolli*s). University of Jaipur, Rajistan. *Rajasthan*?

71 Yadava CPS *et al*. (1999). Report on the work carried out on pheromone studies on ginger white grub *(Holotrichia seticolli*s). University of Jaipur. Rajistan. *see above*

72 It should be noted that this was not an entirely new approach in Sikkim and that the GDTF began work with farmers at Parchey and Lower Tarpin in 1997. The ARD approach was intended to be more a sharing of information between farmers, research and extentionists, in order to formulate trials addressing the major concerns of farmers, rather than testing the 'imposed' technologies of researchers.

73 In fact, this was the experience from the regional trials (see Jackson GVH and Sarma YR 2000). Ginger disease control. Progress report 2 phase II. ISPS, Gangtok. There was no yield advantage in using raised beds.

74 The owner did not want the plots harvested as they intended to save the crop for seed. Consequently, only part of one of 8-9 rows per treatment was harvested by DOH staff.

75 Tarnutzer A (1994). Op. Cit., page 16.

76 Ibid, page 12.

77 During the mission of the Workshop consultant, a 3-day visit (7-9 September 1995) was arranged to the districts to see ginger diseases. The farms visited were those where previous surveys had determined pests and diseases to be present; thus, the overall impression was that the diseases were severe and limiting production.

78 ICAR was already involved in trials testing various rates of FYM and inorganic fertilisers in 1995 (see Tarnutzer A (1994). Op. Cit., page 38).

79 The Secretary of Agriculture was resolved to include the investigation, which was merely a desk job, in the action plan of the GDTF, but it was too technically demanding for the members, none of whom had an expertise in soils.

80 The entomologist from CIPMC agreed to support the work at the Workshop, but did not attend the post-Workshop meetings when the action plan was developed, and took no further part in the programme.

81 Mr Gautam left in 1996, and no replacement was made until 1997 when Mr Tamang joined as Seed Certification Officer. He was unable to fulfil the tasks demanded of the position as he was also in charge of Namli Horticulture Farm. Later, in July 1998, Mr LN Pradhan was recruited, but he had other duties as a member of the Department of Agriculture, and could not visit district staff throughout the State. Mr Mahato left in May 1998, and Dr Neopany in October the same year. Mr Tiwari was recruited as Training Officer in May 1998 (he was transferred to another department in 2000). Mr (now Dr) Rajan joined the GDTF as Long-Term Research Consultant in March 1998. In 2000, all staff were transferred to other duties except the Research-in-Charge, who, on promotion to deputy director, was also in charge of the IPM laboratory. In addition, two laboratory attendants were recruited: a HI in 1997, and a HO in 1998. With the transfer of the HO in 2000, two Muster Role technicians were seconded; one left a few months later. The laboratory staff now consist of one HI, one Muster Role technician and a laboratory technician.

82 Unfortunately, two of the POs left within 3 months of recruitment to the GDTF and were replaced by others who had less experience with ginger and the State programme.

83 The YPO 2000/2001 states: "…. it is apparent that the district structure of the DOH which until recently has been kept rather out of the GDTF related activities are now more actively participating in ginger research and planning and accept the ginger research programme as a clear district task". April, 2000, Gangtok. Page 5.

84 Generally, staff of the DOH do not have duty statements; thus, GDTF members may not have considered them important.

85 The need for formal arrangements was indicated in early reviews of the sector. Tarnutzer (1994). Op. Cit., page 6 states in writing about the workings of national institutions: "….. research topic selection and research agendas are made independently by each institution. Selection criteria are influenced as much by preferences of the institutions and individual researchers as by the importance of a problem in the Sikkimese context. An important goal of research are (sic) publication in scientific journals ….".

86 As a case in point, the GDTF was never able to obtain the lists of seed source farmers used by the annual GOS Demonstration Scheme, even though it was the GDTF's task to monitor them. Instead, district staff chose farmers and, presumably, the names were passed to the CSS coordinator in order to match targets with the funds available. Most seed sources were not evaluated, and hence diseases continued to be spread with planting material.

87 The GDTF was never consulted on the operation of the annual GOS Demonstration Scheme; and never knew its details, until they were revealed in early 2000. Targets for seed distributions were made, lists of seed source growers developed, pesticides distributed, nuclear seed produced at government farms, with little ort no assistance from the GDTF.

88 In December 1997, ISPS suggested the inclusion of the POs and the ISPS Project Executive to strengthen the GDTF.

89 POs as members of the GDTF were supposed to be involved in the development of annual plans and regular reviews, but they were often absent when these were in progress. Unfortunately, use of the POs as the points of contact of the GDTF in the districts had unforeseen consequences: the joint directors felt no obligation to give the work of the GDTF the priority that it deserved. They may even have felt their authority undermined by the GDTF liaising directly with the POs and other junior staff. Whatever the reason, collaboration was weak. The creation of deputy directors (research and extension) as potential points of contact of the GDTF in 2000 came too late, as by then most GDTF members had been transferred to other duties.

90 Initially, consultants were quizzed on the use of Metco as a drench against rhizome rots, the basis of its costs, and that farmers would never be able to afford it. Although true, the chemical was used to assess the effect of the disease, and estimate yield loss. Also, biological control as a strategy for soft rot control was repeatedly questioned, perhaps an indirect way of expressing dissatisfaction with the operation of the project rather than any doubt in the potential of the technology. By contrast, biological control of white grub, using essentially similar technologies, was not questioned.

91 Jackson GVH and Sarma YR (1997). Ginger disease control. Progress report III. ISPS, Gangtok. The progress report written in December states (page 3). "It is disappointing to report that the laboratory is far from complete; in fact, there has been little improvement since last year. ..... there is now no electricity, and equipment has broken down and not been reported as needing repair. A further problem unresolved until the last day of the mission was ownership of the laboratory – the soils section of the Department of Agriculture has suggested that it wishes to repossess the laboratory. An agreement has been reached between the departments that the laboratory will remain with the DOH and renovations will proceed immediately."

92 The failures of the 1997 field trials programme, poor supervision of trials in all years, the time taken to refurbish the laboratory (and the initial acceptance of inferior equipment), and the lack of progress on pathogenicity testing, were only some of many concerns, and led to the decision by the Department to recruit the Long-Term Research Consultant to accelerate the pace of the programme.

93 As an example of this, and a problem that lingered on, was the refusal of the Department to provide the GDTF with extra touring allowance (although an additional allowance was paid by ISPS it was still not considered sufficient). In other words, the GDTF was a special unit, set up to tackle a difficult problem, but in reality, the members were constantly under scrutiny, criticised by headquarters staff, the district extension service and the donor.

94 The YPO 2001/2002 states, referring to all ISPS programmes: "Organisation and day-to-day management of programmes is inefficient and monitoring and supervision by superiors is inconsistent, leading to low accountability of implementing officers and field staff". Phase 1 Assessment, quoted (under Main deficits). April 2001, Gangtok. Page 4.

95 Jackson GVH and Sarma YR (1997). Ginger disease control Progress report III. Review of 1997 action plan and programme for 1998. ISPS, Gangtok.

96 The recruitment of a plant pathologist by ICAR in 2000 saw the development of a ginger disease programme independent from that of the Department of Horticulture, but involving biological control approaches that were similar to those instigated by the GDTF. There was also work on testing native flora for inhibitory effects against rhizome soft rot. Meetings between the DOH, ISPS and consultants in 2000 and 2001 failed to establish common ground for amalgamating the work and pooling resources. The plant pathologist transferred to another ICAR institution in 2002.

97 The Ginger Disease Laboratory merged with IPM in 2002, but as yet there has been no move to develop a plant protection wing serving both departments. The staff of the ginger laboratory have retained their functions, but one Muster Role technician has left, on promotion to horticulture inspector.

98 Tarnutzer A (1994). Op. Cit., page 8 states the prevailing view: "...improvements will come about if more of the same is provided, i.e. the systems are expanded to make farmers finally adapt which is seen as best for them."

99 Ibid, page 11.

100 An annual plan for the GOS ginger demonstration and area expansion scheme produced by the DOH

101 Assessment Report Phase 2. Indo-Swiss Project Sikkim. October 2001, ISPS, Gangtok. Page 22.

102 The programme sought to develop participants' confidence in participatory processes through critical reflection, and to enhance their capacity to act collectively in addressing village priorities. Confidence building of participants was developed through learning skills essential to initiating group or collective action in their communities. Specifically, it aimed at changing farmers' perception from a 'passive beneficiary' to 'active client', thereby eventually assuming more responsibility and control over decision-making process affecting their livelihoods. Prem Gurung (2001). *A Training Report: Participatory Training-Workshop with the Farmers (June 21-23, 2001*). SIRD, Karfectar, South Sikkim.

103 Panchayats from several villages took part in the Participatory Training-Workshop with the Farmers (June 21-23, 2001). SIRD, Karfectar, South Sikkim.

104 DWCRA: Development of Women and Children in Rural Areas; TRYSEM: Training of Youth for Self Employment; IRDP: Integrated Rural Development Program; NCUI: National Co-operative Union of India.

105 See Assessment of Impact of Information on Rural Areas of India, implemented by MS Swaminathan Research Foundation, Chennai: http://www.mssrf.org/informationvillage/assessment.htm

106 Tarnutzer A (1994). Opt. Cit., page 10.

107 Ibid, page 1. The report on the Green Sector of Sikkim describes the 2-year Pre-Phase of ISPS, 1 October 1993 to 31 March 1995, during which several studies were undertaken to build a "comprehensive study framework", and the basis for the formulation of the project plan for Phase I.

108 A mid-term review rather than an evaluation, as it had been decided to continue the project in Phase II, with a greater emphasis on extension.

109 Jackson GVH and Sarma YR (1999). Ginger disease control. Progress report V phase I. Analysis of 1998 and plans for Phase II. ISPS, Gangtok.

110 The overall concept of Phase II (ginger) formulated with the GDTF and documented in Jackson GVH and Sarma YR (1999) Op. Cit., was no less ambitious than that of the previous phase; this was because the research was thought likely to yield results now that ISPS was more involved in its implementation. ISPS was also heavily involved in extension activities, testing PTD methodologies to build partnerships between district extension services and farmers.

111 Further attempts were made in 2000 and 2001 with meetings between the Director of the Department of Horticulture, Director (and later Acting Director) ICAR, ICAR scientists, ISPS and consultants (IISR and overseas).

112 An assessment of the ISPS Phase 2 achievements and shortcomings was undertaken in 2001. It acknowledged the importance of the clean seed programme, and the many years of vigorous research resulting in several technologies that are relevant to farmers' needs, but that participatory approaches of testing the messages were hampered by the lack of a credible research capacity in the State. Solutions were not suggested. Assessment Report Phase 2. Indo-Swiss Project Sikkim. October 2001, ISPS, Gangtok.

113 Tarnutzer A (1994). Op. Cit., page 9, states: "Performance is not monitored, and neither officers nor field staff thus are accountable for their performance. No incentives exist for above average and no disadvantages for sub-standard performance. Political connection seem to be a decisive factor for promotion".

114 Yearly Plan of Operation 2001/2002. April 2001, ISPS, Gangtok.

115 Ibid, page 10.

116 In 2000, approximately 50 per cent of the junior members of the extension service were transferred between departments of agriculture, soils and horticulture. The result was that junior staff, those most in contact with farmers, had little knowledge of ginger and its pests and diseases and needed to be trained.

117 The internal assessment of Phase 1, quoted in the Yearly Plan of Operation 2001/2002, recommends: "ISPS programmes to become part of Departmental 5-Year plans and State resources (under separate budget heads) to be allocated to ISPS programmes (as in other projects)". April 2001, Gangtok. Page 4.

118 There is still a need to complete some research activities on both pests and diseases, but it is now difficult to see how this is to be achieved under present circumstances: the Long-Term Research Consultant has left and ICAR's involvement remains elusive, and requests to Spices Board to undertake some specific activities in 2001, which would have helped to decide if pheromone analyses should be done in 2002, went unheeded.

119 The terms of reference of the consultant assisting the Workshop called for an assessment of current on-station and on-farm research and extension in the action plan to be produced at the Workshop (see Jackson GVH (1995). Op. Cit., page 2).

120 Assessment Report Phase 2. Indo Swiss Project Sikkim. October 2001, ISPS, Gangtok. Page 4.

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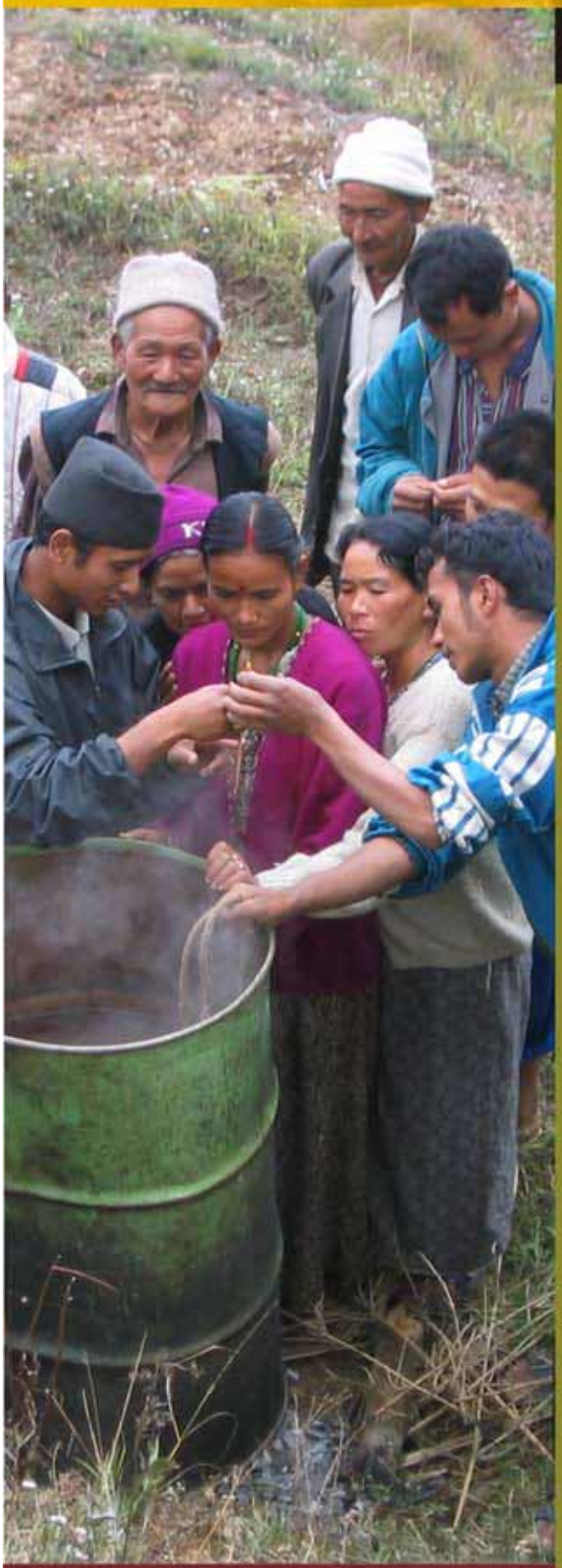

ISPS PROGRAMME SERIES

Ginger is a crop of great importance to farmers of Sikkim. For most, it is the only source of cash. Unfortunately, yields are never guaranteed due to many pests and diseases, some of which can destroy the entire crop. Overcoming these problems began in 1995, with the start of a long-term project between the Department of Horticulture, Government of Sikkim and the Indo-Swiss Project Sikkim, supported by the Swiss Agency for Development and Cooperation and Intercooperation. This booklet documents the experiences of the partners over 7 years, and serves as a resource to ensure that the lessons learnt from the successes and failures are not lost to farmers.

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