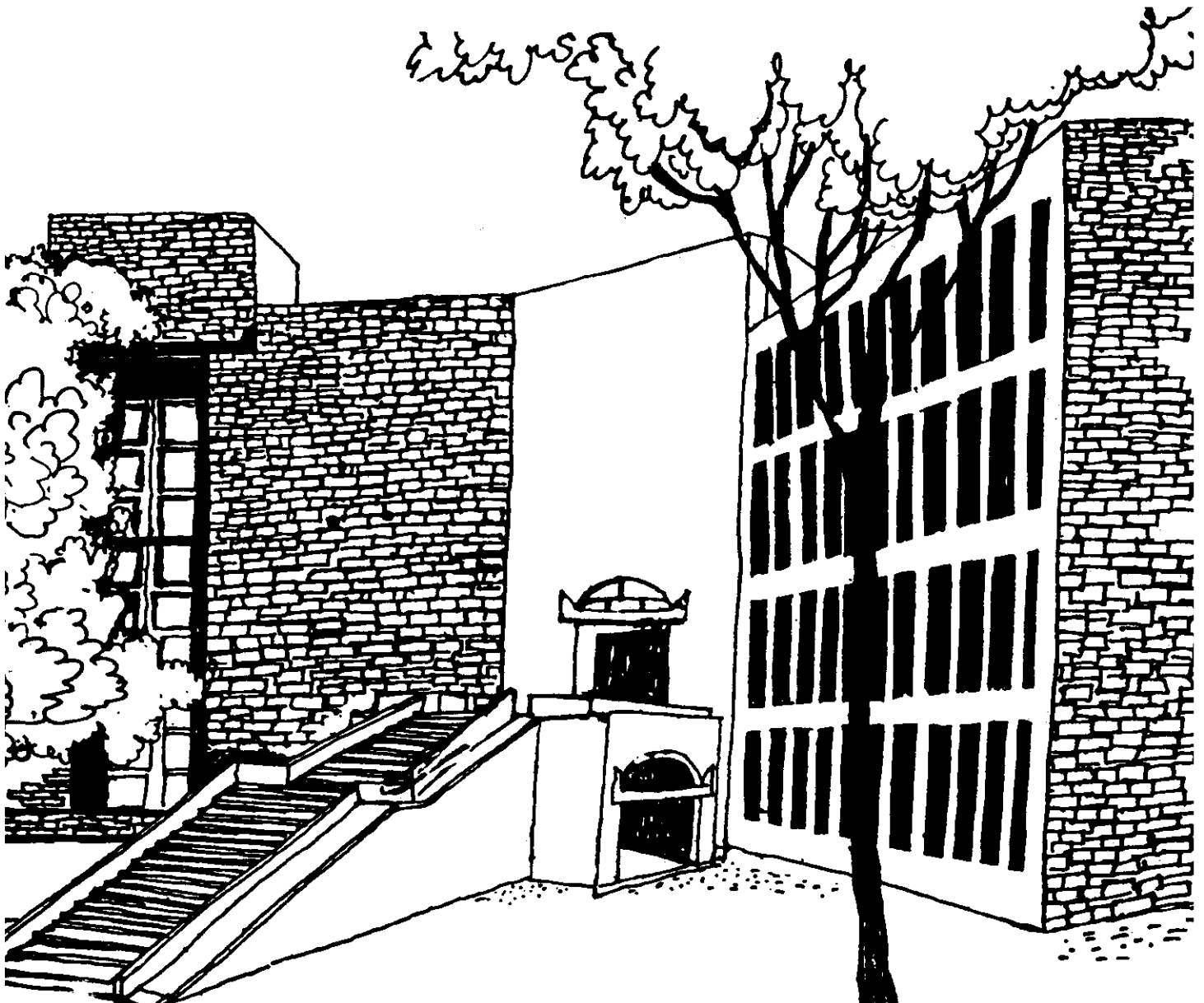





Working Paper



**CORPORATE INVESTMENT IN AGRICULTURE
RESEARCH: ISSUES IN SUSTAINABLE DEVELOPMENT**

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Abstract

The productivity of agricultural inputs has been consistently declining over last two decades. Given the economic squeeze, Indian economy cannot afford to provide resources required for such a non-sustainable use of inputs. Even in the affluent countries, the non-sustainability of external input oriented agriculture is being realised. The excessive use of pesticides and disruption of the ecological chain due to high residual toxicity and treadmill effect; imbalanced use of nutrients and consequent nutrient mining of soil; declining water tables, etc., are some of the early warning signals. Need for maintaining genetic diversity in different crops and thus fillip to national seed industry is another area of urgent concern. Increasing control of Multi-National Corporations in the agri-input industries is adversely affecting the indigenous incentives for R & D for development of eco-friendly technologies.

We have done a survey of Indian agri-input companies to identify the patterns of investment in research within these companies and in public sector universities/institutes. The problems faced by small companies in pursuing R & D and getting support from agricultural universities are highlighted. Several areas of future research and policy modifications are discussed : (a) environmental scanning - how would debate on intellectual property rights in Europe affect the interests of Indian companies - large or small; What should be the role of public sector R & D institutions given global competitiveness and increasing role of private sector; (b) should a database on technological trends be developed for better forecasting and negotiation domestically and globally, (c) what type of fiscal incentives be provided for encouraging corporate sector to pursue R & D, particularly by the smaller companies, (d) should farmers cooperatives remain indifferent to R & D processes, should not cooperative federations invest in specific well defined R & D programmes, (e) how to support research on farm equipment by small artisans, private companies with the for hand tools or bullock, camel or tractor drawn implements. What type of banking support is required for investing in R & D (f) should seed companies not be allowed to lease or buy land for setting up research farms, (g) how should India stake its claim to intellectual property of people, pastoralists, horticulturists and the artisans, (h) can corporate sector build upon watershed projects in dry regions as sites for multi location testing of new technology in different agro climatic zones, (i) can private sector help in commercialization of publicly developed technologies with royalty payments to state, how to strengthen these links (j) can farmers', breeders' (livestock, crop, trees) association be involved in trilateral R & D arrangements with public and private organisations? (k) what should be the role of NGOs, (l) how should private companies share their profits with the people or communities whose technical innovations they have scaled up, (m) how should linkage between credit and technology be strengthened at different levels in the country particularly in high risk environments so that corporate sector is emboldened to invest in R & D.

**Corporate Investment in Agriculture Research
: Issues in Sustainable Development.¹**

Anil K Gupta & Rakesh Singh²

The productivity index of agricultural inputs has declined during last two decade far more severely than ever in past. It stood at less than 60 in 1987-88 with base of 100 at 1970-71 constant prices. It is obvious that such a decline in productivity of inputs would affect the viability as well as sustainability of agricultural production system not in the distant future. There are several factors which have contributed to decline. However, one of the most important factor could be the lack of research on sustainable agriculture jointly by agri input industries, public, private, and cooperative research bodies besides Non Governmental Research Organizations (NGRO). The public sector is constrained by budget squeeze. It is likely to increase in the near future. More expenditure by the private sector and NGOs could bring the total expenditure on agricultural research in line with the returns expected by the society. But the current trend in corporate investment in agricultural research does not sound very encouraging.

We present in this paper issues emerging from a survey on corporate investment in agricultural research within their companies as well as in public sector agriculture research organizations. Only partial results are available and thus indications given are quite tentative in nature. We have also listed the areas of cooperation between corporate sector (public, private or cooperative), NGRO and public sector agricultural research institutes and universities.

We strongly believe that major breakthrough in agriculture sector in future would come only through collaborative research between input industries and research scientists on one hand and the farmers on the other. We also realize that this collaboration would require changes in public policy as well as corporate objectives. Sustainability in agriculture production and consequent viability of farm investment is crucially linked to the correspondence between long term interests of the farming households and short term commercial interests of the input industries. The challenges is to face the trade off boldly .

Part One - Declining Productivity of Agriculture Inputs:

Fertilizer and pesticide consumption has increased by more than 300 per cent during 1970-71 to 1988-89 where as the food produc-

1. We are grateful to all those agri-input companies which have responded to our mailed questionnaire. Thanks are due to Mrs. Sunita Srivastava for help in revising the paper and Mr. Sethumadhavan for word processing it.
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tion has increased by only 57 per cent during the same period (Gupta, 1990a).

Productivity of fertilizer may have been declining on account of following reasons:

- a) Imbalance in the use of macro and micro plant nutrients. The sustained mining of micro nutrients without replenishing the same. The disturbance in the soil micro organism base and limited application of organic fertilizers,
- b) Continued recommendation of fertilizer inputs on the basis of crops rather than cropping system through the extension system,
- c) Interaction with poor water quality in regions where the same is a problem,

In case of water the productivity has declined because of factors affecting soil and surface and ground water such as

- (a) Declining groundwater table and increased consumption of energy for uplifting same amount of water,
- (b) Ingress of sea salinity in some of the coastal regions,
- (c) Water logging and/or rise in the water table due to poor drainage,
- (d) Erratic distribution of water and power by public systems affecting conjunctive use of ground and surface water. Erosion of soil quality affecting productivity of water and other inputs.

The productivity of pesticides has declined because of

- (a) excessive use of chemical pesticides leading to a sort of treadmill effect,
- (b) not only the pests have been killed but also the predators,
- (c) increased resistance among the pests,
- (d) inappropriate adaptation of implements for applying the pesticides leading to wastage through air drift or other means,
- (e) lack of manipulation of agronomic parameters such as crop geometry and sowing time to reduce the incidence of pests,
- (f) increased cropping intensity and irrigation leading to round the year availability of alternative hosts besides favourable humid micro environment for pests. In addition, the breeding for yield has invariably implied a trade off in favour of higher vulnerability to diseases and pests through genetic linkage. Many pests have adapted to new hosts and in the process the specificity in pest attack and pesticide application is reduced. Around 60 percent of the total pesticides is consumed just in case of cotton. The recourse to suicide by Andhra farmers last year is just a pointer of the things to come.

pesticides is consumed just in case of cotton. The recourse to suicide by Andhra farmers last year is just a pointer of the things to come.

The declining productivity of seeds has been a major source of concern because of low replacement ratios, multiplication processing and distribution bottlenecks and lack of incentives for small seed companies to invest in R & D. The declining genetic diversity increases the probability of diffusion of disease and pests.

It has been recognized that maintenance research to adapt biological technology across various eco-systems to maintain the productivity (Bonnen 1987:111) has to grow in proportion to the ecological diversity. In India while National Agricultural Research Project deals with the strengthening of regional research capability it is obvious that the task of eco specific technological generation and adaptation is so large that it is beyond the capacity of either public or private sector research alone. If we add to this agenda the problem of research on minimizing or eliminating the negative effects of chemical, fertilizers, pesticides, and weedicides then the task become even more complex and gigantic.

Part two : The patterns of corporate investment in agriculture research:

There have not been many studies which have looked at this problem. Pioneering work has been done by Pray (1985, 1986); Nayar (1983), Hobbs and Taylor (1987) Sinha (1983) & Jain and Banerjee (1982), Pray and Echeverria (1989). The study by Pray like ours was also constrained by being dependent on a very small sample (n=25). Studies by Pineiro (1986), Donovan and Lynas (1988), Gupta, Patel and Shah (1990), and Duvick (1988) have provided only partial insights on one or two dimensions of the problem.

There is no doubt that USAID has invested in this research in India essentially to generate a more congenial policy environment for unrestricted freedom to large multinational corporations for patenting their research outputs including plant and animal varieties or breeds in India . At the same time paucity of data and systematic analysis of the one available from Association of various Indian Agri-Input industries and the scientific community has meant dominance of conjectures over reasoned analysis .

The studies in U.S.A. reported that the private sector of the agricultural industry spends from approximately US \$ 1.7 to 2.6 billion per year on agricultural research, depending upon the assumptions made from the data available from the companies in ARI survey. It was revealed that 356 companies spent a total of US dollar 1370, 775, 670 per year in agriculture research during 1983. If one could assume that the non reporting companies numbering 322 also spent resources at the same rate the total expenditure would be about \$ 2610, 634, 416 with average per company expenditure at \$3850493 (Crossby 1987:402). The maximum

expenditure was in the area of pesticides. Around 50 percent companies did not do any relevant basic research while five companies reported 100 percent basic research.

University of Minnesota initiated a study in 1984 of research by private agri-business in the third world (Pray 1987). It was reported that India spent (in thousand dollars) 833 on seeds, 3500 on pesticides, 6775 on machinery, 2275 on livestock, 3324 on processing and plantation. Total private research investment was 16707 thousand dollars and government funded agriculture R & D was 24830 thousand dollars. The private expenditure stood at 7 percent of the government research and 0.03 percent of agricultural contribution to the gross domestic product in India during 1985. The corresponding share of private research was as high as 63 percent in Philippines and 24 percent in Malaysia. As is well known unlike Philippines and Malaysia, India has pursued a much more vigorous policy of self reliance in agriculture R & D. It has also provided relatively speaking lesser incentives to private agri business for doing research. While plantation and processing industries have been far ahead of others in terms of research investment the seed industry was till 1985, the lowest contributor to research in the private sector. Situation might have slightly improved in last 4-5 years.

Pray (1986, 1987, 1989) has made important contribution in finding out the major impact of private technology transfer and research in countries like Indonesia, Thailand, India and some other developing countries besides USA. It was found that in Indonesia the government research had not contributed much to the private research programme. Major impact of private technology transfer and research had been in the plantation sector but the major constraint had been the role of government enterprises in both the input supply industry and the plantation industry. However, in Thailand poultry industry had been the main area of revolution with regard to improved technology and research. New improved breeds and feeds had important impact on increasing export and reducing import. Pray (1989) found that in US, public R&D was larger than private R&D in crop breeding and management, nutrition and livestock. Mechanization and post harvest research were dominated by the private sector. Only rapid shift in the relative size of the public and private sector was in plant protection.

The main objectives of private sector agricultural research and technology transfer in developing countries are highlighted by Pray and Echeverria (1989) as

- i) to identify the characteristics of private sector links which could be used to improve links between research and technology transfer in public sector.
- ii) to study the government policy to strengthen the links within the private sector and between the private and public sectors.

It was concluded that government policies and regulations influenced the amount of private R&D, the nature of the links and the type of people who operated them within the private sector and between the private and public sector.

Findings of IIM-A Survey:

Our survey initiated in December, 1989 generated a very poor response in terms of the number of companies supplying the information. It is obvious that unless we receive a much better response from the companies it is very difficult to generate a viable policy dialogue on the subject. Some of the key insights which emerge from the survey are summarized.

1. Out of 28 companies which responded only 15 had the internal R&D department. Among those which had R&D department research expenditure varied from Rs.4 lakhs to 128 lakhs per annum and the manpower from one breeder and four assistants in a seed company to 76 persons in a tractor company.
2. Among various reasons for not investing in R&D, finance appeared to be most important constraint followed by the statement that the company concerned did not see any need for investing in R&D. A Cooperative marketing federation observed that being involved only in formulation of pesticides it did not see any need for internal R&D. In some companies demonstration on the farmers field were treated as a part of R&D. Unless data from the experiments was analysed to develop location specific technologies it would be difficult to justify such classification. However, it may be useful to explore the possibility of strengthening capacities for processing data even if collected from demonstrations. More systematic trials will be facilitated by processing data of earlier demonstrations.
3. Only 7 out of 28 companies have sponsored research in agricultural universities on problems ranging from fertilizer response, climatic analysis to fabrication of equipments (at IIT and other technical institutions). It appears that most organisations whether in public or private sector have not explored the possibility of collaboration with agricultural universities. When asked whether research institutes had approached them for collaboration, 9 out of 28 responded affirmatively including two which were not successful in establishing contact with the concerned university. It is interesting that in one case a company in cooperative sector was approached by research institutes for trials on pesticides against stored grains pest. However, from the data it appears that the public R&D institutions should also take more proactive measures to seek collaboration with the corporate sector. We did not come across any instance where the technical capacity of the corporate sector had been responsible for public R&D institution requesting collaboration. Perhaps the idea of

collaborative R&D is still a far cry.

4. When asked about the problem faced in conducting research only three private sector seed company complained that despite having completed all the formalities they were not getting much help. It was mentioned that even to get periodic progress report companies have to visit the university and agricultural universities rather than getting the same in the normal course.
5. We were interested in finding out whether companies which did not invest in R&D internally and externally would like to plan collaboration with agricultural universities in future. 17 out of 28 companies felt that there was indeed a scope for strengthening the R&D. There were a few seed companies which were collaborating with ICAR in All India Coordinated Research Projects. Interest was expressed much more by the seed companies than others. In view of the modifications of the ICAR'S policy toward 'network' research, the possibility of specific problem solving type of research being contracted to corporate sector are much more now Gupta, 1990c).
6. Only few companies like (IFFCO and Rallis) had funded chairs in agricultural universities. It doesn't need to be emphasised that this is one area where multinational corporations and large companies in private or cooperative sector could have taken lead (our data is severely limited in this regard).
7. There were only four companies out of 28 which provided post-graduate scholarships.
8. Regarding grants to the public R&D institutions there was one cooperative federation and one private company which were planning to provide such support. The private company proposed to give 30 percent cost of a particular facility as a grant provided they got income tax rebate. Five companies out of 28 were considering giving or had given grant.
9. In terms of participation in the national and international science conferences only seven companies responded positively. This is another area where scope of immediate strengthening the relationship between public and private systems exists.
10. On the question whether they had considered the possibility of taking help of agricultural universities for solving their marketing problems, only two replied positively and two said that they had never thought about it.
11. In view of the complex problems of less developed regions such as rainfed drylands we had asked whether companies would like to work with the state agricultural universities

or ICAR institutions banks and other development departments. Sixteen companies out of 28 showed interest in such collaboration though none had specifically taken any initiative. One of the company complained that these state universities prefer state sector companies rather than private companies while developing collaborative arrangements.

12. We wanted to know whether any fiscal or other policy measures of the government needed modification to encourage collaboration between industry and research systems. Fifteen companies responded positively but major suggestion which were given ranged from concessional facilities for product testing, grants for setting up R&D division and availability of liberal financial assistance for strengthening such linkages.

In addition to above some of the companies suggested removal of other constraints such as exemption from land ceiling laws for developing field trial facility, entitlement for foreign exchange from banks for import of germplasm and speedy quarantine clearance.

The issue of land ceiling laws is quite complicated but needs careful rethinking. For instance, for companies with proven research competence it may be necessary to allow acquisition of lands for establishing field trials. Care will have to be taken that seed multiplication should be done as far as possible on the farmers field so that objectives of R&D do not conflict with the objective of employment generation. Government could come out with the policy for seed companies having competence and capacity to hire technical people and use modern facilities to acquire land for experimental purposes. Alternatively seed production cooperatives may be formed as organizations of farmers to work closely with the seed companies to develop technologies.

To avoid misuse of scarce resources such as foreign exchange, government may publish all the entitlements and the exemption from land ceiling laws so that social audit may take place through media awareness created by concerned consumer organisation.

Part - Three : Areas of Collaboration between public, private, cooperative and NGRO research systems: Review of studies.

It is apparent from the previous discussion that there are major gaps on both the sides. For instance, the fact that no agricultural university is apparently doing much basic science research on developing new products whether in the case of fertilizer, pesticide or weedicides should cause us some concern. Their primary role in testing the products obviously implies under utilization of the enormous research infrastructure which has been built in the country. On the other hand many large companies in public, private or cooperative sector which make profits through sale of agri inputs are making no investment whatsoever in R & D in their own organization or in the agricultural univer-

sities or ICAR institutions. Oehmke James (1985) observes about the persistence of underinvestment in public agricultural research that:

- i) demand for research increases over time.
- ii) the funding agency responds slowly to the change in the needs for research. Therefore, actual funding lags behind optimal funding.

Due to this scarcity of resources, only those projects were funded which had high rate of return. Glenn Fox (1987) pointed out that incentives for private food and fiber research and producer funded research are much more. Prey (1983) could not find much interaction between private and public sector. He found numerous examples of private firms giving grants to universities or public research organization to finance research. It was observed in his study that only five companies out of 32 provided the grants for research.

There is need for a proper dialogue between research planners and corporate leaders in this regard. Further, Research on research policy should be performed by the public sector and private non profit organizations. It must also be emphasized that programme of exchange of personnel between industry and university would be valuable for development of research. It was further suggested (Pray Carl et al 1989) that government or foreign financed programmes encouraging joint R and D might increase contacts and mutual confidence in the quality of each others' research programmes.

An earlier study (Prey, 1986) had revealed that companies viewed the public policy for local agricultural research as unfavourable. It discouraged the investment in R & D by:

1. restricting the growth of firms which limits their ability to capture the returns to research;
2. requiring licenses for expansion of plants and production of new products which increases the uncertainty about being able to commercialize the results of research, and the returns to research by adding years between invention and innovation;
3. restricting the areas in which large firms and foreign owned firms can invest or do research, i.e., farm implements and seeds;
4. the absence of product patents on agricultural chemicals, pharmaceuticals, agricultural equipment and plant varieties;
5. import restrictions on prototypes, germplasm and scientific equipment.

In South and South East Asia private research was found below the

optimum level. In particular, private sector research on biogenetic research in USA was limiting in its scope. Pray added that those companies which felt that the government encouraged the research observed it happening through:

1. import restrictions on pesticides, poultry chicks and eggs and agricultural machinery and limited patents in chemicals
2. government research particularly seeds research seems to have benefited but also the tractor industry and poultry industry mentioned government research having been useful to them;
3. educating scientists which the private sector can then hire relatively inexpensively (Pray, 1986).
4. companies being allowed to commercialise the innovative product.
5. government investing in higher education and financing scientists for overseas training.
6. technical support from government research organisations.
7. countries should eliminate laws of regulation that prohibit private research.

Pray observed that in the seed research private sector had concentrated primarily on hybrid corn and sorghum (besides vegetables). It was proved statistically (Pray and Ruben 1988, also see, Pray, Ribeiro, Mulia and Rao, 1989) that seed imports and private research were closely related and could be an important source of improved technology. It was concluded that countries which restricted the import of corn seed are losing out an important source of growth in productivity. The research by multinational seed companies (MNCs) could be a source of growth. Policies restricting the activities of multinational seed companies may also impose cost on farmers in terms of foregone productivity. The tractor and animal feed were assumed to have benefited from the liberal import of technology in the earlier stage of development followed by protection at the later stages. The pesticide research was primarily in the private sector though Indian chemical research was believed to concentrate on process innovation rather than product innovation. It was argued that protection of property rights of inventors through patents and plant breeders right and allowing foreign companies to do research in bio-technology besides better cooperation between public and private research would help in the long run. In the following areas the dialogue on science and technology policy needs to be initiated:

Part-Four : Areas of Future Research collaborations

Many of the ideas mentioned here are debatable. We feel that identifying areas where dialogue between industry and agricultur-

al research system needs to take place is more important than finding out where it should not.

1. Environmental Scanning

It is obvious that both micro and macro environment within the country and outside will need to be properly scanned to fully utilize national research capacity. Given the experience of various developing countries in dealing with multinational corporations the apprehension on the part of public institutions is understandable. At the same time if corporate sector has to grow it cannot but share its own market intelligence with the state institutions in areas where national interest are involved.

For instance the plant breeders rights in Europe are being extended such that in future any company will be prevented even from incorporating a small part of the patented germ-plasm. The EEC directive on patenting of life form "seeks to end both these exemptions. Article 12 of the directive seeks to extend patent protection to ' the product initially obtained by the patented process, but also the identical or differentiated products of the first or subsequent generations obtained therefrom. Similarly Article 13 stipulates that the patent would be applicable to all products in which genetic information pertaining to patented product has been incorporated" (Economic Times, Feb 13, 1990). The small European companies would find it very difficult to compete with large European and American Seed companies. In such a conflict both large and small Indian seed companies in India could suffer. Dialogue on such issues must take place so that public policy can be enriched by the insights that corporate sector in public or private sector may be able to more easily gain compared to the bureaucracies. The notion that public sector is inherently poised to protect public interest is no more valid. State bureaucracies are known to be slow in identifying and responding to the global market and technological challenges.

In context of the variability in the micro environments within the country, use of market research techniques by the corporate sector might generate ideas from the consumers needing attention from the public R & D institutions. A study on Matching Research Objectives with the Farmers' Concern brought out the importance of various sources of ideas in generating research projects. It is obvious that not often these ideas flow from corporate sector to public research system though one can not say the same thing about the reverse process (Gupta, Patel and Shah, 1985).

In some cases public R & D has to compliment private efforts, for example, just like international research

institutions under CGIAR (Consultative Group on International Agricultural Research) develop basic germplasm and make it available to national centres, the public institutions within the country should involve various agencies in the private, public or cooperative sector to adapt technologies to different ecological and social conditions. This could happen only if proper attributions are made and due acknowledgement is given for mutual help. Sharing of environmental information, therefore, is closely related to the development of mutual trust and definition of mutual responsibility.

2. Technological Forecasting

Given the global competitive environment and dominance by the large multinational companies in the agricultural research sector particularly chemicals and seeds, there is a need for building alternative scenarios of technological change. In the Eighth Five Plan working group on agricultural research and education a suggestion has been made that a group on Technology Alert and Assessment will be set up for the purposes of technological forecasting as well as identifying gaps in internal R & D strategies. There is no provision for corporate sector to participate in this group obviously because bridges are yet to be formed between public and private research systems. During the negotiations for international collaboration Indian public R & D system may not always be able to extract the best terms and for the right technologies given its weak data base. It is desirable, that import of technologies in areas where indigenous capacity exists is restricted.

3. Fiscal Incentives for R & D

The policies to encourage expenditure on R & D have not been very successful in encouraging corporate sector to spend on both internal and external R & D. Discussions with scientists in different agricultural universities revealed that the resources contributed by the corporate sector were almost negligible. On the other hand, there are large companies in public, cooperative and private sector dealing with agri inputs like seed and fertilizer which spend practically nothing on R&D either within their organization or outside. There is a need for Association of Industries and ICAR to set up a working group in collaboration with Ministry of Economic Affairs and Agriculture to review this process. Budget constraints have weakened the public R&D a great deal over last few years. In many universities the contingencies for scientists have come down in real terms over last decade. The need for corporate investments has therefore never been higher (Gupta, 1987a, 1987b).

4. Incentives for Small Companies

At present Agricultural universities do not discriminate between small and large companies while charging fees for products testing. An agricultural university charged amounts ranging from Rs.6 to 10 thousand per crop, per product, per season, per center. As one seed company mentioned if the trial had to be continued for three years, the Rs. 33,000 had to be spent at one center alone. If one has to try a product say on ten crops at three centers and for six seasons (three years) it would cost about Rs.18 lakhs excluding the cost of material, manpower and money spent on supervising the plots. A question has been raised whether a small scale unit manufacturing agro inputs could spend so much money. It has been suggested that norms for charging fees should vary according to the size of industry.

We came across another instance where a non toxic herbal pesticide viz.Indiara has been developed by an entrepreneur in Pune. The entrepreneur is facing precisely the problems mentioned above in getting clearance from Central Insecticide Board. We suggest that a National Fund could be established by Government or by corporate philanthropists or by associations of Industries for promoting R&D for sustainable agriculture especially earmarked for supporting trial on technologies developed by the small entrepreneurs. We do not think it would be possible for universities to subsidize the trials. However, we do think that for herbal non-toxic products, universities should propose very low cost trials. This is an area where apart from the fiscal constraints small scale industries also face extra-ordinary competition in media and distribution channels.

The cooperative federations for different commodities being farmers' organizations should come forward in a big way to support field trials under scientific supervision on low toxic pesticides and other growth regulators or promoters Donovan and Lynas, (1988) and, Fox (1987) have also argued for increased role for producers association in R & D. It may be useful to levy a small fee as done by the sugar factories (for infrastructure development), for the purpose of strengthening R & D. The promotion of investment on R&D should not rest entirely on public fiscal incentives. Resources must be mobilized from farmers or companies' own resource besides through the endowment set up by the large private and public sector. It has to be acknowledged that various fertilizer and other companies have not made major endowments to promote R&D except IFFCO which has set up chairs in 11 universities. In addition, KRIBHCO provides scholarships to the students and Rallis has also set up chair in an university. There are companies like National Seed Corporation which neither have an internal R&D nor invest in any public research system. Likewise one of the state marketing federation informed that they have neither

invested on R&D within their organization nor conducted or collaborated with agricultural universities and ICAR institutions because they did not see the need for it. This is a situation which needs to be urgently reversed.

5. Promotion of Internal R & D

Memorandum of Understanding may be worked out between public and private institutions for secondment of the staff to each other's institutions depending upon respective strengths. So far the arrangements for contract research do not exist in the ICAR system. Given limited resources, barriers to collaboration between public and private sector particularly small scale private sector must be overcome so that the process of technological change can be expedited.

6. Farm Equipment Research

Director, Central Institute Of Agricultural Engineering and Dy Director General, ICAR (Agri Engg) in personal communications regretted their failure in building stronger linkages with the industry for prototype testing, multiplication and commercial sale. Dr M V Rao, till recently Special Director General, ICAR felt that the next decade will experience technological breakthrough with the help of farm implements. Meetings with artisans and small and large scale manufacturers have to urgently take place to identify institutional space for R&D on this subject. It has to be admitted that despite decades of research we still do not have reliable and cheap bullock drawn seed and fertilizer drill available in most parts of the country. Hand tool is another area which has been neglected by the universities as well as corporate sector. Though there was a time when even pickaxe was manufactured by a large business house in India. Fuel efficiency in pump sets is already attracting attention of manufacturers. But diffusion of simple innovations for improving fuel efficiency has been very sluggish. NABARD had invested in such a study earlier but has not done enough in this regard. Special line of credit will be needed for upgradation of manufacturing processes in cases where such upgradation is largely argued on social concerns rather than on the basis of purely corporate profit objectives. Fiscal policies which make investment in R&D of such nature obligatory have to form part of the modernization package (also see Gupta, 1989c).

7. Seed Industry

The working group on Managerial Strategy for Agricultural Development during 8th Plan (G.O.I. June 1989) suggested that seed management requires advance planning and adequate risk adjustment options. Suggestion was made that in view of the inability of state government to fulfill seed

production targets government should contract out the production of seeds of specified quality on a tender basis to private seed producers. The guidelines for monitoring seed supply in different parts of the country for different commodities will then need to be established.

The new seed polity announced on September 16, 1988, instead of confining itself to import of germplasm permits generally usable seeds. This will cut short the native efforts for hybridization and weaken the research base. This policy will permanently make the seed industries dependent upon MNCs instead of investing in R & D.

It was recognized that the tenancy laws might not permit large seed farms by the seed companies. The contract farmers it was feared might sell the seed to the competitors. It is obvious that with increasing importance of seeds these questions cannot be deferred indefinitely. There are many other issues which affect R&D on seed as mentioned below:

- (a) The negotiations under GATT on the protection through the patent for germplasm indicate that even transfer of part of genetic material from an improved variety to another variety would not be permitted. This is seen as a move by large seed companies in Europe to prevent small European seed companies to compete with them. The implications for R&D in India are obvious. If the parents of various crop varieties or land races collected from third world and pooled by international agricultural research centres are made available to large seed multinationals without charges, then on forward exchange of information cannot be questioned. This involves a position to be taken by Indian seed companies and Indian R&D institutions together. At one level the conflict between large and small seed companies in India become less conspicuous compared to the conflict between Indian and foreign companies. At another level, it is possible that Indian subsidiaries of large seed multinationals might be able to transmit germplasm or part of it to the parent companies without any hindrance. Unlike repatriation of profits, repatriation of germplasm was much easier. This is an area where both ethical and scientific norms remain to be developed. It will be desirable if the industry took initiative to develop guidelines and norms in this regard.
- (b) It has been known that the genes for disease and pest resistance are always found in the high risk environment (Vavilov Centers of Genetic Diversity) because of high genetic diversity. It will be useful to establish some norms for sharing the rent extracted by the company with the group of people who have preserved that variability and gene in particular locality (Gupta 1990c). In the process, these communities have remained poor through the companies using these genes have become richer.
- (c) Government has showed a renewed concern for development of

dry region through watersheds planning. Karnataka has set up dryland development board to take up watershed development in all the districts of Karnataka state. They have already taken up seed production and testing with the help of department of pathology, Mysore University and marketing at a cost lesser than Karnataka Seed Corporation. There is a case for collaboration between private seed companies and watershed development programmes in various parts of the country so that scarce moisture conserved through public investment in soil and water conservation yields higher returns through improved technologies. This will generate demand for soil and water conservation technologies also. If medicinal plants could be included and if marketing of non-edible oilseeds through trees could be organised further value will be added to the conserved moisture in drylands. There is a need for seed associations and manufacturers to take up this issue for dialogue with Central Research Institute of Dryland Agriculture Hyderabad and ICAR. The director of technology mission on oilseeds in Ministry of Agriculture may also be involved in the dialogue to help formulate national policy on the subject (Gupta, 1987a, 1989c).

- (d) There is no doubt that demand for some of the non-edible tree oilseeds was generated in India (e.g. neem and sal seeds) by multinational corporations through their Indian subsidiaries under compulsion to find substitutes of imported tallow (Pray, 1986). Therefore, it is not inconceivable that some areas of constructive cooperation can be identified where through proper regulations and social audit deleterious effects if any, of such domination by large companies could be taken care of. Consumers association will need to be strengthened by association of industries and other groups. Watchdog function will have to be performed by these consumer groups and professional scientific associations.
- (e) Given very low seed replacement ratios in self pollinated crops the private seed companies may participate in the multiplication and distribution of the seeds in such crops rather than in development of varieties. Likewise the state distribution system could also accept hybrid seeds developed by the private companies for diffusion through public extension system at reasonable cost. The issue is that the role of state agricultural research systems is not adversary to corporate sector. There are limits to the extent to which certain functions can be performed in specific organizational settings. We are aware of a cases where Farm Managers in agricultural university gave priority to allocation of experimental land for seed production rather than for research experiments. Top executive wanted to monitor the performance of farm managers by the revenue generated rather than support provided to the scientists. This is patently a case of misplaced priorities. At the same time we should not ignore the compulsions behind such practices. Corporate

sector will have to share part of its profits with public R&D system if it would like mutually supportive roles and responsibilities to be properly pursued.

8. Role of Framers' Organizations

In addition to what has been stated above, it may be added that farmers movement and organizations have not given enough attention to monitoring of R & D by corporate and public systems. They have not argued for participation in the process of technology generation itself. Grape producers in Maharashtra are perhaps the only one group in the country who have set up a research centre of their own. On the other hand Cooperative Federation of Cotton in one state refused to cooperate with a small scale producer of herbal pesticides because he could not provide free samples on large scale. Government has to advise and persuade various associations of producers to atleast develop facilities for On-Farm Research in rainfed regions where technologies can not be transferred from the research station due to high ecological heterogeneity. In commodities where farmers' associations do not exist such as in millets, sorghum, pulses etc., the task is more difficult. Industry may have to come forward to form users associations to encourage farmers participation not in just transfer of technology but also in the development of same. Science transfer rather than technology transfer will have to become the mainstay of technological change in high risk environments (Gupta, 1989a, 1989b, 1989c, 1987b, 1985).

9. Corporate Ombudsmen for promoting R&D

Albrandt and Blair (1986) have suggested that some of the large companies may like to create an institution of corporate ombudsmen. He is a person in a company who is outside the normal reporting relationships willing to hear ideas for R&D and nurture them across the channels and hierarchies. It is an idea which we think is all the more relevant for companies seeped in bureaucratic cultures.

10. Mutual Monitoring of Trials

One way in which trust between corporate sector and the agricultural universities can be fostered is to create joint monitoring teams for designing and monitoring respective trials on station (Duvick, 1988) or /and on-farm. This will have to be done on experimental basis and only for certain category of trials.

11. Low External Input Sustainable Agriculture (LISA)

US Congress allocated \$14.5 million in 1989 as against \$13.9

in 1988 under the Food Security Act of 1985 for LISA. The purpose was to trigger research on organic farming, non toxic herbal pesticides and other such inputs besides encouragement of fallowing for recuperation of soil health etc. In advanced regions of the country we are facing a crisis of similar nature. Farmers will shift land from crops to trees or other enterprises to overcome the problem of reduced profitability or demand more and more subsidies. Given large budget deficits we do not think subsidies can continue indefinitely. Sustainable alternatives have to be found. Botanical insecticides, insecticidal soaps, microbial insecticides (Alternatives in Insect Management, Illinois, 1989) have been attracting a great deal of attention in the west though not yet in India. Advantages are that these products have rapid degradation, quick action and low mammalian toxicity, selective and less harmful to some of the useful insects, and low toxicity to plants and of course low or nil residual effects. Disadvantages have included the factors like : greater need for more precise timing due to rapid degradation, cost, lack of test data etc.

In the context of developing countries we may mention that we have compiled an Inventory of Peasant Innovations for Sustainable Development (Gupta, Capoor and Shah, 1990). It includes a long section on ancient and contemporary knowledge on botanicals among other things. Corporate sector can access these recipes and try to build on farmers' own technical knowledge. Our submission is that part of the profits companies may derive from such recipes may be shared with the people and their organizations or institutions who have helped develop this knowledge. It may also be useful if proper credit is given to the generators of knowledge so as to boost the pride of people in their knowledge. Corporate sector could also fund setting up a national centre for documentation and experimentation on indigenous knowledge .

12. Non Governmental Research Organization

BAIF is one of those few organizations in voluntary sector which are collaborating closely with the public R&D systems. A NGO centre on research on hand tools is working in Bardoli in Gujarat. It may be useful if, corporate sector can help in scaling up and marketing technologies developed by the small NGROs. Being close to people, NGRO have an advantage in identifying client needs and converting them into research problems. However, this will also depend upon the ideological foundation and professional competence.

13. Credit -Technology Linkages

At present science and technology institutions in private public sector do not participate in any of the Credit Coordination Mechanisms at central, state, district and block

levels (Khanna, 1989, Gupta, 1986). There is a need therefore to break through this impasse. We have taken initiative in this regard in Karnataka in collaboration with Dry Land Dev Board, three banks and University of Agri Sciences. Investment in inter-organizational networks is one of the most efficient and cost-effective ways of utilizing redundant resources always available in any organization (Gupta 1989). Action Experiments are needed to explore further the potential of this idea.

There is a need to recognize that large areas still remain to be explored in strengthening corporate investment in agricultural research with in their organizations as well in public systems. Healthy competition will do some good to all the actors. However, we have to realize that there remain some problems which receive low attention in public research systems and certainly in private or corporate system. Whether, corporate sector will recognize that the long term sustainable regionally balanced development is in its own interest and whether it will work towards it remains to be seen. Institutional innovations are needed to link, promote, support and sustain investment in R & D by involving public science systems, NGOs, Farmers' organizations and scientists' volunteers. Will the corporate sector respond to this challenge?

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