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DYNAMICS OF PESTICIDE USAGE AND GROWTH IN  
AGRICULTURE IN DEVELOPING COUNTRIES OF ESCAP REGION<sup>1/</sup>

by

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<sup>1/</sup> The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariats of ESCAP and UNIDO. This document has been reproduced without formal editing.

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I. SUMMARY

1. The world's food problem is getting aggravated and very few countries are completely immune to periodical shortages. Increasing populations pose a difficult problem for developing countries in ESCAP region, where family planning measures will take long to have an impact. The outlook for the next 20 years will be bleak unless agricultural productivity can be increased by minimizing losses - pre - and post-harvest on food and other crops, some of which earn valuable exchange, an essential input for long term industrial and economic growth.
2. Pesticides can effectively reduce losses given scientific support of pest management in relation to production, distribution, and market development. Because of their specialized nature, pesticides can only be propagated under quality supervision and control.
3. The consumption of pesticides in developing countries is broadly in accord with experience in developed economies but there are differences in terms of suitability/selection of materials applicable from one country to another, depending on the agro economic situation. Scientific planning for pesticides is therefore a difficult task and needs constant review and analysis, with the aspect of ecology now adding another dimension to complexities of future planning.
4. A common problem in the developing countries of ESCAP region is to get the farmers in the unorganized non-plantations sectors to accept the techniques and methodology of modern agriculture on the basis of 'pay-off' experience. As the industry is research-oriented and resource-consuming, a regional/sub-regional approach for production and placement of pesticides might help to accelerate developments, in production and promotion, including a possible share on the ancillary of training through improvement of skills.

5. The size and growth of chemical industry in each country determines local manufacturing capability. It is unthinkable for all developing countries in the region to take to production of even a small proportion of the 900 odd pesticides discovered during the last 30 years by sophisticated chemical research.

A regional framework is suggested to initiate

- (i) new production of technical products;
- (ii) services including promotion measures, institutional supports, training and development, etc.;
- (iii) exchange of knowledge and worldwide experience in the context of toxicity, safety, ecological developments and liaison with U.N. bodies and agencies concerned with the subject of pesticides for use in agriculture and public health.

#### New production

6. There are staple products and "sophisticates" and local manufacturing in the context of regional marketing potentials seems feasible for some staples. These were identified by the joint UNIDO/FAO mission in 1973. The following are recommended for production, as soon as possible, as a start:

Thailand -- DDT and toxaphene

Indonesia -- DDT and/or BHC, with medium term possibility for thiocarbamates and gradually on the herbicides derived from petroleum raw materials

Philippines -- Copper sulphate and oxychloride.

7. The choice of the above products can be defended from the aspects of technology transfer within the region through bilateral or other means. Investment support from respective governments would be necessary on which some suggestions are made.

/Formulation

### Formulation

9. Like technical products they can also get outdated. Theoretically, adequate capacities exist all over the region but their working has to be modernized bringing in the aspects of technological change and improvement, quality control and managerial inputs. Raw materials, additives and equipment are available within the region. A modern formulation unit has potential for generating opportunities for employment and training of this sector needs immediate and sustained support.

### Services

9. Academic research facilities already exist at a high level but some means must be found to bring them into the mainstream of active promotion of pesticides. Sharing of functions, crop-wise is recommended. Extension is a weak point and footwork has to be strengthened with the help of governments, manufacturers of pesticides and through the use of specialists team of 'green collared managers' built up from agricultural and engineering graduates supported by financial help from banks.

10. These new teams of private operators can take over demonstration work on behalf of governments and also service the private land-owners already converted to pesticide usage, on straightforward contract terms. Meantime, a comprehensive study to identify the weakness in extension on a regional basis is called for.

### Training and development

11. Pesticides need marketers with technical and commercial knowledge and a degree of involvement; Formulation and marketing training must be a permanent part of development programmes and a regional centre is advocated for theoretical and practical work including evaluation of raw materials, additives and developments of new formulations and design of application equipment.

/Knowledge exchange



Knowledge exchange

12. Scientific work during the last ten years has led to classification of hazardous and non-hazardous products from the viewpoint of environment control and safety of operation, from manufacture to the point of consumption. Choice of safe products is obviously the ultimate objective but the relative cost is an equally critical factor. UNIDO, WHO, FAO are all concerned on behalf of the developing countries to select suitable pesticides for agriculture and public health and international programmes are likely to continue. All countries in ESCAP region have a keen interest in reaching a suitable consensus on preferences to be attached to individual products and achieve a balance on what is desirable as well as practicable, against the background of FAO/WHO findings on the one hand and the essential needs of agricultural and human productivity on the other. It is recommended that a monitoring cell on the subject be established as a definitive part of the regional, technological/development centre mentioned earlier.

/II. INTRODUCTION

## II. INTRODUCTION

13. Inflation and low agricultural productivity have been the two important subjects of debate among the critical issues during last three years. To the developing countries these have been of critical importance particularly because of the world food problem in the context of rapid expansion in population. However, 'there is no time for the third world' as an eminent economist has put it, and the problem of world food availability makes it imperative that all possible measures be adopted quickly to add up to the availability of food, both qualitatively and quantitatively. A serious nutritional problem arises from the uneven distribution of food supply among countries and within countries. While there may not be any world wide shortage of food in terms of quantity (calories) or quality (protein) on a global basis, in developing countries where two-thirds of the world's population live there is evidence of under-nutrition and mal-nutrition. According to FAO, the poorest 25% of the people consume diets with calories and protein contents far below minimum requirements. This does not mean that nothing is being done to increase output of food. It simply means that population growth is much faster than incremental agricultural production. (Please see Annex 1)

14. The present trend is unlikely to change and the world's population is estimated to exceed 5 billion in 1985, and 7 billion in the year 2000. The world food problem is therefore an immediate threat. Unless this is solved within the next twenty years the situation could become unmanageable later. If the reality of the critical food shortage during the next twenty years is accepted, two important issues arise namely stepping up of family planning and secondly improved agricultural output both in terms of productivity and conservation. Intensification of family planning even if successful can at best make an impact in the next generation through cumulative effects. Meantime there is no escape from improving agriculture productivity using all

/the means

the means science and technology have placed at our disposal. This would not only assure a better per capita intake but also add to the quantum of cash crops which earn valuable foreign exchange for the economy at large to bolster industrial plans and employment potential.

15. Modernization of agriculture in developing countries particularly in South East Asia is no longer an open question; it is the method and mechanics of achieving modernization which pose problems. Following the experiences of developed economies most governments in South East Asia have accepted the role of new agricultural strategy focussed on improvement of farm technology and management, to suit the individual needs of each economy. However, the progress has generally been slow as new thinking has not been able to permeate deep enough to the producer's level. Reasons may be non-availability of inputs in time or inadequacy of infrastructure, advisory and technical services; or shortage of cash with the farmer, or a combination of all these factors.

16. Modernization of agriculture in developing countries is synonymous with the progress of the Green Revolution which, in simple terms, involves effective usage of

- i. water i.e. irrigation (whether rain-fed or through other means)
- ii. seeds
- iii. fertilizers
- iv. farm equipment
- v. pesticides

17. It is the scientific deployment of all the inputs which influence increased output. Without water, quality seeds and equipment the impact of fertilizer is lost; even if all these are there, the crop gains are

/lost

lost if pesticides are not available in the stage of growth and in the post harvesting process, i.e. storage and distribution up to the consumer's end.

18. It is estimated that in Asia up to 15/20% of agricultural produce is lost annually because of pests. Taking the case of India, it is seen that in 1973/74 the losses in agricultural output were equivalent to over \$5 billion i.e. a little more than India's total foreign exchange earnings in 1974/75. India's experience is typical of the situation in South East Asia and it is reasonable to conclude that unless effective steps are taken to popularise pesticides for greater production and effective distribution of agricultural commodities, the Green Revolution will not be sustained.

19. There are many difficulties to be overcome, some arising from the very nature of the products, others flowing from lack of economic resources and inadequate infrastructure of production bases, training, development and marketing channels, and forward planning, etc.

20. The purpose of this symposium is to discuss the interrelated problems of increased production in relation to the use of pesticides and to seek viable solutions, particularly with reference to the situations prevailing in FSCAP region.

/III

### III. PESTICIDES - CHARACTERISTICS AND PROBLEMS

21. The pesticide industry is comparatively very young, with most developments and progress dating from the end of World War II. However, during this last 30 years constant research in agricultural and chemical products has led to the discovery of new products as well as modification of the old ones. There is no strict comparison with fertilizers. Whereas there are about a dozen fertilizers established, the total number of pesticides which have emerged from chemical research is around 900/1,000, and the 'family' of pesticides now comprises many groups such as insecticides, fungicides, weedicides (including growth regulants), rodenticides, fumigants. This is understandable as the strategy for control of any pest has to be based on a number of factors such as efficacy (cost/benefit) of the pesticide on the target, the effect on other organisms, on soil, water and atmosphere, i.e. ecology, and also ready availability at the time required in the form required.

22. Use of pesticides being dependent on a number of variables, the adaptability of pest control measures lends itself to a system approach which is commonly applicable to promotion of industrial products. Strategy, selectivity and control are the important components. This makes the task of pesticide promotion difficult indeed, yet if the regional or sub-regional attributes of agricultural productivity are to be optimized, the principles of pest management found successful in developed economies must be translated in suitable forms to fit in with the needs of individual cropping patterns encountered in ESCAP region. Just as the development of small-scale technologies has been adapted in smaller countries without jeopardising the basic principles of science and technology.

/The following

23. The following characteristics of pesticides are worth emphasizing:

- (a) Use of pesticides is now akin to medicine with comparable roles in diagnosis, prevention, treatment and control. Competing products selective-vs-broad spectrum - toxicity and residual effects are a few features of the problem. The diagnosis of diseases and treatment of crops are not ends by themselves, and workable answers, depend on availability of crop technical service and formulation as near the points of consumption as possible.
- (b) Fear of product obsolescence and the uncertainty on adequate returns from this capital intensive industry, through application of new technology in a small consumption area, has often inhibited new entrepreneurship. Also, trained manpower in more than one discipline (a synthesis of agriculture, industry and management) is an essential requirement to promote the use of pesticides.
- (c) Although promotional effort by governments and civil agencies, supported by quick communication media, has led to the establishment of pesticides in ESCAP region the pace of progress has varied from country to country in the context of the supports for indigenous manufacture, deployment of foreign exchange resources and the availability of the requisite infrastructure.
- (d) The growth and development of the chemical industry has an important bearing on manufacture of pesticides and their availability to the farmer, direct or through such agencies as the situation in each country (or cropping area) might require. Pesticide production, historically, has been related

/to the

to the rapid progress in utilization of minerals and the progress of petro-chemicals in its connection with manufacture of organic chemicals forming the basis of plastics, resins, dye-stuffs, and other important areas of the chemical industry all over the world.

- (e) The progress of fertilizer responsive high-yielding varieties of crops attracted increased use of pesticides as these varieties are more prone to pest attack; a change in the relative incidence of pest has been experienced and unknown pests have posed a problem in crop protection. For instance a larger use of fertilizer has meant a demand for greater weed control measure. As time passes this fundamental shift in the demand and market for pesticides might get accentuated leading toward demand for newer types of materials with their own specific usage and benefit. The comparison with curative drugs is obvious.

#### IV. CONSUMPTION TRENDS.

24. Annexure II is indicative of progress in certain developed and developing countries. Because of the fast growth rate over a short span of time precise projection on future usage cannot be forecast with accuracy to cover all countries in different stages of economic development. The progress of new research and development, difference in application of products, differential agricultural practices, ruling possibly for the same crop in two different countries, complicate the nature of data available from different sources. However, the consumption pattern experienced in industrialized countries is getting endorsed in developing countries to the extent that the use of insecticides leads ultimately to a greater demand for herbicides and fungicides. As manual labour become expensive, herbicides will assume a greater role in developing

/countries

countries. Insecticide of vegetable origin will also attract attention, together with some emphasis on biological control of pests.

25. Although the basis for selection of pesticides in developing countries might be different from the consideration applying to other countries with differential costs of land, labour and inputs, there is no disagreement on the infrastructural needs of application know-how through adequate formulation capacity and marketing channels. In addition, job training programmes for operators and technicians are essential everywhere.

26. It has been established that the quality of technical supervision is an important factor in determining the current and future potential uses. No wonder controlled schemes in well managed farms have given better results than in small individual holdings lacking technical back-up and supervision.

27. Agricultural products in ESCAP region are important foreign exchange earners. This is badly needed for the overall economic growth of the countries. Therefore export crops have traditionally received priority attention. Happily, this experience has been most useful and has set good trends for applied product research bearing on the usage of pesticide. This organized structure if projected over a wider area would offer expansion of potential.

28. But there is a very big 'if', consumption trends are a resultant of the interplay of a number of forces under diverse management and control. Variables are many and any intelligent planning for maximizing pesticidal operations has to analyze constantly in scientific and economic terms on the factors and decide on the options. Facts impinging on the usage of pesticides might be summarized as follows:



- (i) Government policy concerning promotion of agriculture - the role of incentives/benefits offered for individual areas of agricultural and industrial production. Patterns of imports/exports. Duties/tariffs.
- (ii) Price trends; Patterns of current consumption: Product/Areas/Crops/Plants: past trends and future projections allowing for product displacement and substitution.
- (iii) Local manufacture and future plans:
  - Technical grade pesticides
  - Formulation
  - Indigenous sources of chemical raw materials, equipment and know-how
  - Ancillaries - Fillers, spraying/dusting apparatus.
- (iv) Availability of institutional supports - agricultural research centres, universities, data collection, extension work. Role of private industry and product associations.
- (v) Personal availability - product/crop managerial experience, training and development programmes.
- (vi) Miscellaneous:
  - (a) Standardization
  - (b) Geographical location of inputs
  - (c) Transportation and freight costs
  - (d) Adequacy of finance/credit
  - (e) Environmental/ecological development and their impact
  - (f) Experience on toxicity and harmful residues.

29. New concepts on hazards, toxicity, residues and ecology have been superimposed on an existing complex situation. Yet all the work must be done -- a task expensive and, probably, too large for at least small countries in the region.

V. NEED FOR A NEW OUTLOOK

30. The cornerstone of economic progress of any nation being development of its natural resources and manpower, it is important that countries in ESCAP region concentrate on agriculture as a foundation to build self-sustaining productive economies. It is also relevant that the growth of the entire national economy of a country is needed for the future to increase agricultural production, which will depend on the farmer's ability to purchase inputs which will be the output of industry. Farmers will thus need to sell a major portion of their harvest in good condition to be able to become prosperous enough to become suppliers as well as consumers of products. The chicken and egg relationship is there.

31. To persuade farmers to accept the techniques and methods of modern agriculture is not easy; in traditional subsistence economies of Southeast Asia the cultivators fear new risks as most of the time they are close to the margin of poverty. If a farmer is to invest in modern inputs of improved seeds, fertilizers and pesticides, these resources must be easily available to him together with a system of farm credit so that he can afford to purchase them. He would also like to be instructed in the proper and economic utilization of these products and be assured that he will be compensated for losses incurred in the process of innovation. Finally, he must be shown that the potential pay-off is worth the risk.

32. To induce farmers to change the potential pay-off must be not 5 to 10% but 50 to 100%. Adoption of deep wells for irrigation in West Pakistan is an example. In five years nearly 32,000 tube-wells were installed at a cost of \$1,000 to \$2,500 each on farms no larger than

25 acres in the cotton and rice regions of Punjab. A private investment of \$50 million was made by traditional farmers without Government subsidy. The wells paid for themselves in two years, proving the pay-off as large enough to make the farmers change. How this pay-off is to be established in pesticide appears to be too big a problem for individual countries. The 'club' approach might therefore be well-worth a discussion.

33. All clubs are not the same; the constitution of a club assumes some common interests, objectives and obligations. It cannot be denied that there are a number of common problems for agriculture in this region; we have primarily rain-fed agriculture subject to fluctuation in output between the good and bad years of monsoon. Agricultural infrastructure for transport and storage is not fully developed and growth of intensive technological agro chemical industries is slow. Pest control programmes get limited in scope with emphasis on fire-fighting rather than in advance planning through prophylaxis. All these lead to inadequate crop protection.

34. Although all countries are not in the same stage of development in terms of production of pesticides, agricultural education, extension and marketing services, etc., there is a common denominator of low agricultural productivity in an environment of critical dependence on agriculture for a large proportion of population with a common expectation and rationality of improved standards of living.

35. The pesticide industry is technologically oriented and high resource-consuming. There is an urgent need of courtship and collaboration within the region to help one another to create extra output of crops and to build skills and jobs ultimately needed to back up new industries. 'Going it alone' is time and money consuming and a suitable arrangement of regional co-operation is what the times demand.

/Assuming

Assuming acceptance in principle of the concept of regional/  
sub-regional co-operation, certain imperatives arise. Any multi-national  
effort requires footwork to identify areas for priority action in the  
context of potentials on a regional basis. The linking of one country's  
strong point with the gaps in others, whether technological or commercial,  
needs extensive study to determine feasibility of product demarcation.

36. Cognizance has to be taken of the availability of local inputs.  
As, basically, the collaboration will hinge on manufacturing, the nature  
and quality of such collaboration will have to be carefully worked out,  
not forgetting the aspects of shared investment and technology including  
that to be transferred from outside the region. The influence of economy  
of scale and markets overall in the entire region as a unit will have to  
be examined with export potentials included.

37. Information for guidance of different countries must be gathered  
as a continuous process and this might need a central clearing house for  
feedback. The twin aspects of product research and development in this young  
growth oriented industry are of fundamental importance to help in bridging  
the technology gaps and associated problems relating to process and market  
research based on application and experience. It is for consideration  
whether some of these central-servicing functions cannot be tackled with  
the help and guidance of some organs of United Nations like FAO, EDCAP and  
UNIDO.

38. For the purpose of regional co-operation the key requirement is of  
optimisation, which in the context of the inventory listed on page 8 would  
cover the following areas:-

- (1) New production of technical products and their formulation.
- (2) Services - promotional measures, institutional supports;

/personnel

personnel availability and training and development programmes, market research and product development.

- (3) Exchange of knowledge and worldwide experience of different countries e.g. the context of toxicity and ecological developments.

39. All the above areas have relevance to saving on costs and time-lag in relation to agricultural practices found successful elsewhere in the world.

a) Pesticides production

40. Technical products are, basically, chemicals of organic and in-organic origin and their manufacture is subject to well understood norms of technology and viability. The entrepreneur must consider what to produce, when to produce and how to produce. Identification of new pesticides, besides with difficulties in the total range of established products is very large (about 900/1,000) and the list is still growing; some of the items are used in very small quantities while others are large turnover products. A steadily growing range of chemicals made with sophisticated chemical technology is thus offered for almost a fixed number of crops. This can daunt any prospective manufacturer who might take a view that there might be better products coming along offering bigger potentials for usage and profitability. Product obsolescence being a common feature of the industry, the entrepreneur would be naturally worried whether the product will last long enough to make his investments worthwhile. Also, the market development being subject to imprecision, decision making becomes slow. Fortunately, the rate of obsolescence varies from one product to another. There are 'staples' which might be regarded as the 'old faithful' like BHC, DDT and copper fungicides which are still in popular use and would

/continue

continue to be in demand because of the fertilizer facilities already built. It might be a good idea to incorporate these 'staples' in the first instance.

41. About 60 technical products are now manufactured in the ESCAP region including India and Japan, covering a remarkably large area of application. Production of these products in other countries can be extended within the region.

42. The first step towards regional self-reliance was taken through a joint UNIDO/FAO Mission in 1973 to the Philippines, Indonesia, Malaysia, Thailand, Nepal, India and Afghanistan and the pre-feasibility survey of pesticides production in these countries in the ESCAP region has been circulated separately. Admittedly, the country list could have been more comprehensive but this report underlines the basic objectives and identifies the first few projects which need priority attention. In brief new projects are recommended for Thailand, Indonesia and Philippines, in the 'staple' products.

43. Thailand DDT and toxaphene are suggested. The former is still the cheapest and simplest pesticide regardless of the overtones of pollution and ecology engendered in developed economies like USA and Western Europe; the latter is a product derived from local raw materials, i.e. pine-compene. For DDT, chlorine and alcohol are other raw materials and Thailand has potential sources of supply including alcohol from fermentation of sugar molasses. Thailand's neighbour next door, Malaysia, could join in the DDT project because of its surplus chlorine.

44. Indonesia Chlorine and ethanol are also available in Philippines and Indonesia but the latter can provide also benzene. Ideally, both BHC and DDT could be recommended for Indonesia and it would be a question of choice whether to have one or two plants for DDT, i.e. both for Thailand and Indonesia. To the above list one could add possibilities in Indonesia

for thiocarbamates (including thiram and ziram), tetradifon; paraquat can be considered because of prospective availability of cheap local raw materials derived from the oil (ethylene, methanol, benzene, chlorbenzene, naphthol, pyridine) and because of the plant which is under operation producing carbon disulfide.

45. Philippines has developed copper mining and could undertake manufacture of copper sulphate and copper oxychloride with minimal requirements of imports.

Annexes III and IV show:

Raw materials needed for important pesticides already popular in Southeast Asia.

46. The choice of the above products can also be defended from the aspect of technology transfer within the region. Bilateral possibilities for the products recommended exist. Marginal technology from outside of the region, if necessary, should not be too expensive.

47. Regardless of the composition and nature of project share-holding, the Governments in the countries concerned must be willing to give full support to the projects in the interest of promoting agriculture. This can be in terms of activating new productions as well as in promotion. The latter is discussed in a subsequent paragraph but in relation to production this should be in the form of incentives such as:

- (1) Exemption from payment of custom duties for all equipments and raw materials not available within the country with permission to import equipments as a part of foreign investment, if required.
- (2) Special financial arrangements and low interest rates to apply to loans given by banks for pesticide projects.

- (3) Transfer of complete plants to be permitted, if feasible.
- (4) Profits made by the enterprise should be income tax free for the first 10 years.
- (5) Special dispensation by municipal governments on infrastructure of services, i.e. water supply, drainage, etc.

48. Some of the above incentives have already yielded good results in other developing countries particularly Brazil where the pesticide industry has made a pronounced progress. A short profile on the country is attached - Annex V

49. It is felt that a beginning made with a few products will build up a base to generate expertise and motivate diversification as the technological capability in each country grows in time with the market potentials.

50. The required data on investments has to be up-dated because of the oil crisis in October 1973 when the UNIDO/FAO Mission first carried out the survey.

/ (b)



b) Pesticides formulation.

51. Unlike fertilizers, pesticides are rarely applied neat; they must be mixed with diluents i.e. solids like talc, or liquids, solvents and even water, the mixture being prepared in simple plants and equipment for blending, packing and storage. Additives such as wetting agents, emulsifiers, dispersing agents are also used. Given the technical products of standard quality the other ingredients and machinery are all available within the region; there is also a reservoir of experience in different countries, built up over the last 15/20 years and gaps can be filled through mutual arrangement.

52. Making of formulations is not so much a technical as a market-directed operation. Where to make it will be determined by the demand pattern, subject, of course, to criteria of feasibility e.g. total market value, local availability of ingredients, easy location of services like semi-skilled labour and qualified managerial, technical and scientific, staff. Theoretically, a manufacturer of technical products is best suited for making formulations through vertical integration of his operations. However, while technical control may be his forte, he will also have to depend on outside supply of many products. A decision must therefore rest on the market need, bearing in mind that an Asian farmer is endemically short of cash to build any inventory. He would prefer to buy as and when he requires a particular product and the source of supply should be within his easy reach, may be two to three days transit. That is why each country must have a large network of formulators in addition to the manufacturers of technical products who will spearhead application research and product development through technical sales service.

53. The relative economics of small and large units is often debated; agricultural applications being seasonal, it may not be possible to ensure 12-month usage of every plant but against this one must weigh the advantage

/of an easy

of an easy availability. The dull period can be used by the technical operatives for maintenance, study and preparation for the future, laying in raw materials, packaging, investigation of competitive sources of supply etc. as in the sugar industry.

54. In the context of the regional problems it should not be forgotten that formulation plants have become centres for new small-scale industry. Even though a low level of technology is involved, these units create employment and generate opportunities for training and development in the modern art of industry through acquisition of new techniques of production and quality control. Manpower trained initially in formulation thus updates itself with the progressive trends in the country. This has economic advantages and builds up management and expertise at the grass root - a very useful social attribute.

55. Formulations can also get outdated. There is a need for regular feedback and exchange of experience within the countries of the region on improving types of formulation. Lastly the problem of environment, safety standards and legislative controls should be tackled on a regional/subregional basis, to avoid unhealthy repression on the products and their applications.

56. There is also a pressing requirement of positive steps to reduce the costs of formulations to the utmost. Labour and staff costs can be kept in control through usual means of periodical reviews of work load but the expensive components being the technical grade base and ancillaries Governments of different countries can help in operating a "convention" or a form of customs union in that, any technical grade basic chemical ingredients or equipment imported for agricultural and public health formulations from other countries within the same region, should be free of import duties or other levies such as excise, sales/purchase taxes etc. This will provide incentives for new formulators and also help utilization of such surplus capacities as might exist within the

/region

region. Sea, air, road and rail transport add progressively to the cost and this intra-regional concession would go some way to reduce the burden on the formulator and benefit the farmer.

#### VI. SERVICES AND PROMOTIONAL MEASURES

##### (a) Research Institutes - harnessing

57. In view of the many variables involved there is a need for a management oriented approach to the problem of promotion through integration of components having a bearing on the usage. The technical products (and their formulations) are the heart of the system no doubt but promotion of applications and growth are its important arms and feet.

58. Fundamental/applied agricultural research facilities already exist in the ESCAP region; these have grown during the last 20/30 years to deal with general and specialized aspects of crops and commodities. Product development centres are spread in Indonesia (Central Research Institute, Sugarcane Institute, Institutes for Estate Crops, Tobacco, Cellulose, Tea and Rubber Research Centre, etc.), Thailand (Forest Product and Biological Research Centre), Malaysia and Philippines (Rodent Research Centre, International Rice Research Institute), Pakistan (Cotton Committee & Institute). In India infrastructure on research, development and advice is available from 12 research and commodities stations including on tea, rice, tobacco; 10 important agricultural universities have been established, patterned, on the lines of land Grant Foundation in the U.S.A. There is no dearth overall in the developing countries of ESCAP region of such bodies. However, not all of these are directly effective in promotion of pesticides which process has been left so far to the pesticide industry, i.e. producers of technical products, mainly affiliates of overseas companies

/who

who have to depend on imports in a large way from which formulations are made, the market channels being their distributors (Sophisticated formulations are also imported). Each company has interest in a small number of products and a constraint is obvious. Also competing products are being sold. Whereas all these in any sophisticated economy would lead to the expansion of usage of the best products, in an under-developed country this can bewilder the farmer, who has insufficient knowledge to guide him.

59. There is a need for a closer involvement of the research institutes and pesticide firms in promotion, e.g. selected institutes should take over responsibilities for the particular crop in the aspects of applications, for the entire region. For instance, work could be shared as follows:

India - tea

Malaysia - rubber

Thailand - rice, forestry

Indonesia - tobacco, sugar, oil

Philippines - rice

Pakistan - cotton

etc.

60. The resources of the institutes will have to be augmented and a framework for participation in product development devised for the benefit of the entire region.

(b) Extension

(i) As far as the cultivator is concerned, he wants:

- i. a creditable product (with record of performance);
- ii. an effective distribution point;
- iii. local advice close to him on prevention of disease on crops and attention to his complaints if things go wrong, i.e. expert information in identifying the pest and selection of product for treatment;

iv. prices and term of business he can afford.

61. All the above factors rest on the assumption that the farmer knows and is convinced about the role of pesticides in crop protection. This brings into focus the need for adequate extension work and demonstration. Unlike industrial raw materials intended for a few points of consumption, lines of product development and marketing on pesticides run long and deep into the countryside.

62. In the ESCAP region, extension is a weak point and has inhibited development and usage of pesticides except in large plantation with managerial infrastructure. The problem is exemplified by annex VI for six important agricultural states in the Indian Union. When it is remembered that India is the second largest producer of pesticides in the entire ESCAP region, next to Japan, the role of extension becomes clear, as the following figures of unutilized capacities in India will show:

<u>Year</u>	<u>Capacity (tonnes)</u>	<u>Production Technical (tonnes)</u>
1964	26660	10863
1965	35141	12670
1966	37900	14137
1970	59914	26000

(Source: Pesticides Association of India publication)

63. It is unthinkable that capacities would have been left unutilized if the demand had been built up. Need for improving extension was endorsed India's 5th Plan document for the period to end 1978/79.

64. There is an urgent requirement for a special project study on how extension work can be stepped up and the existing weakness overcome. Helps from UNIDO/ESCAP for this project seem necessary to cover the entire region.

/(c)

(c) Role of Associations of manufacturers/consumers, etc.

65. Associations in developing countries, are generally conceived in terms of confrontation and frequently get into conflict with one or the other sector of the economy, including with Government. Importers' associations have to protect their limited franchise and ask for maximum imports, and local producers of similar products appeal for protection against them; consumers want both the categories to carry the cost of development and yet sell at the lowest possible prices. Even though in theory they have a common interest, in practice promotional measures get obfuscated.

66. In pesticides, the sectional interests involved are:

- i) Basic manufacturers of technical products
- ii) Importers
- iii) Formulators
- iv) Users - agriculture, large estates, public health.

67. Overhanging above them all, in developing economies is the responsibility and role of Governments who have to maintain a balance on what is required in line with their policies on foreign exchange earnings/utilization and industrialization. It is unrealistic to expect one product association to deal with the situation and also acquit itself effectively by helping in promotion. Who is going to pay for the services and how is it to be funded?

68. A workable idea seems to be to devise a split of the "horizon" into (i) organized, (ii) unorganized sectors. (i) should comprise the large plantations with developed infrastructure of agricultural management and (ii) small private landowners and extension demanding undeveloped farmers. The organized sector should be the responsibility of importers and manufacturers - they themselves are the product of urban culture of commerce and can deal with

/the requirements

the requirements of promotion, -- any progressive importer must be assumed to be a potential manufacturer. The unorganized sector being a large one will have to be serviced in a different way through some government or private agency. There would be a case for farmers' societies for individual crops and areas, which can be encouraged to achieve consumer grouping with a core of common interest. Formulators will have to remain an individual entity serving both the sectors on mutually acceptable terms of business. The subject is worth debating in the symposium against the background of experience in participants' countries.

/ (d)

(d) Use of private crop protection contractor - green collared managers

69. Assuming that Governmental machinery has not achieved the objectives, an alternative worth considering is the sponsorship of a co-operative endeavour through creation of small firms where agricultural graduates and diploma holders in engineering could band together with institutional support of finance through Banks (at concessional interest) to purchase spraying machines applicator equipment and jeeps, etc. and undertake plant protection work on custom basis. The output of qualified graduates is adequate in the region, and as in formulation units, this will create new jobs and reduce the burden on Government budgets for maintaining large establishments. These crop protection/management companies might grow up in time as important limbs of agricultural promotion drawing their economic sustenance from output of business (for demonstration and extension work from government and servicing contracts from private land owners who may offer their own labour), and technological guidance from research stations and agricultural departments of Governments, and thus help in filling the gaps of infrastructure at the field level, for service as well as market research and development.

These technocrats co-operatives could diversify into stocking points of pesticide and formulations, if they so desired. That should be a growth prospect.

(e) Distribution and credit

71. The Asian trader is a shrewd operator, he will stock materials if the business is there and give credit if he can rely on the debt being repaid. The situation will vary from country to country and from one area in the country to another. Generally speaking, all Governments in South East Asia are seized of the problem and a rigid regional structure would not be feasible.

/(f)



(f) Training and development

72. Quaintly enough pesticides are sophisticated products to be propagated to unsophisticated users. This requires marketers with technical knowledge, which must be up to date, and also salesmanship of more than average quality. Such techno-commercial expertise is currently in short supply in all developing countries, including in the ESCAP region. Therefore, training and development requirements are and will continue to be the crux of any effective programme of promotion in terms of adequate personnel build up. Whereas, manufacturers of technical products have their standard international drill on job training, the aspects of formulation and marketing will need a cohesive support which will be most economical to provide on a regional basis.

73. Manpower shortage as well as research and development effort can be alleviated by establishing somewhere in the region a combined training/information model formulation plant which can act as a centre for

- (i) Theoretical and practical training facilities;
- (ii) collect and disseminate information on formulation methods and techniques; also develop new designs for application equipment like sprayers, dusters, etc.
- (iii) chemical and biological testing of active ingredients, fillers etc.
- (iv) biological and toxicological evaluation of experimental formulations;
- (v) development of prototypes and marketing models workable in the developing countries of the region.

74. The emphasis will be on a year round programme of courses including on production and evaluation of pesticide formulations. (UNIDO's experience in Bucharest on a joint Romania/UNIDO project of this nature can be useful in organizing such a centre).

(g) Knowledge exchange - legislative measures, environment and ecology

75. Pesticides are chemical products of varying toxicity to human beings and other organisms, affecting them in different ways. Although the most important, agriculture is only one large consumer of pesticides, other uses are in the home and for public health pest control services such as locust and mosquito control, rat control, etc. There are para-industrial usages, e.g. in railways such as for weed control; Hazards to human beings are thus involved, at all levels from production of technical products until the ultimate consumption, through the chain of formulation, packaging, storage and handling in distribution.

76. Aspects of harmful residues/environmental pollution are now attracting attention, and scientific work during the last decade has led to classification into pollutants which are hazardous and non-pollutants which are safe, and basic research in zoology and environmental control has helped a better understanding of crop pest life, environmental impacts and ecology, to provide methods of control of destructive species, such as bats and rodents, and to help increase the population of useful species through environmental manipulation. Meteorologists are studying the possibilities of forecasting epidemics and likely infestation of pests. All very complex indeed, particularly in the absence of a global approach and consensus on suitable alternatives to pollutants.

77. Administrations (civil, agricultural and industrial) in the developing countries face a near dilemma in the context of:

- (a) choice of products and their propagation in relation to cost and popularity;
- (b) safety and control of operations;

/(c)

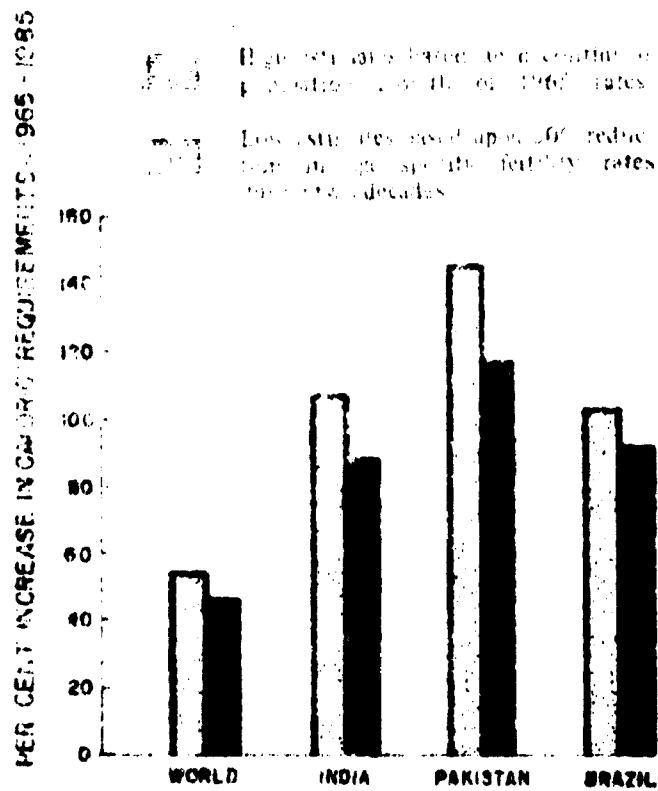
- (c) the dichotomy of the situation i.e. play safe by avoiding use of harmful products and face the risk to agricultural and human productivity from controllable diseases or use products which are allegedly pollutants;
- (d) a lack of definitive replacement programme within the resources of developing countries.

78. Fortunately three international agencies, WHO, FAO, and UNICEF (UNICEF are a large buyer of pesticides for their own programmes, and also on behalf of individual countries) have been engaged on the various aspects of the problems and especially WHO have been concentrating on the technological aspects involved for over 20 years. Their collaboration with FAO extends to toxicology of pesticides, safety of food additives and there is a joint expert committee on pesticide residues and classification. Developing specifications of pesticides suitable for agriculture and public health is a part of their programme, the main purpose being to achieve a compromise on what a manufacturer can make, user wants and can afford to buy bearing in mind the aspect of safety. These programmes are expected to continue.

79. In view of the common interests in the ESCAP countries already discussed, a centre in the region to monitor research and development through exchange of knowledge and expertise is indicated. If the centre advocated in the earlier paragraph is created, a cell within it can be housed to take care of all the aspects of ecology and other relative developments, to maintain a regional liaison with WHO/FAO and develop workable guidelines for the ESCAP countries.

80. The impact of new thinking on environment accompanied by the incidence of mounting costs of chemical pesticides, in the wake of the energy crisis, has induced a greater awareness and interest on the need to evaluate alternative products. Consideration of insecticides of vegetable origin such/<sup>as</sup> alkaloids, pyrethrins, etc. is one aspect and biological control by parasites and predators is another; repellents, sex attractants and behaviour control products are receiving attention. However, on the basis of known experience, even the most promising products have been found to have limitation in agriculture and public health, in terms of restricted applicability in narrow areas.

81. Research and development continues in UN and non-UN sponsored schemes and there seems a growth potential in the long term, but for the immediate and short term problems of agricultural productivity, in the coming years the brunt will have to be borne by chemical pesticides. Meantime the proposed information cum training centre in ESCAP region can undertake marshalling of data/experience and its dissemination to countries to keep them au fait with the developing situation.



Projection of Caloric Requirements for the World, India, Pakistan, and Brazil (Ait Redrawn)

### Annex I: Population Growth and Food Needs

Population and food problems affect the countries already poor, with deficient diets

Food needs might double in 20 years, and intensive family planning plus agricultural modernization can prevent further deterioration.

ANNEX II

CONSUMPTION TRENDS

- (a) World sales of pesticides, 1970
- (b) World use of pesticides by groups
- (c) Cost per lb. of commonly used insecticides
- (d) Consumption trends of different categories of pesticides in developing countries
- (e) Pesticides - Consumption trends in developing countries.

- Notes:**
1. The attached tables were compiled for UNIDO in 1973, from country information submitted at the Pesticide Workshop, May/June 1973;
  2. Value figures are only indicative (being pre-oil crisis);
  3. Projections up to 1980 worked out for selected developing countries to illustrate the possible growth patterns, in terms of product groups i.e. insecticides, fungicides, herbicides, etc.

World Sales of Pesticides 1970

	Value		% of World Market
	\$ m.	£ m.	
USA	1300		45
Canada	60		2
Federal Republic of Germany	220		8
France	170		6
U.K.	90		3
Netherlands	60		2
Sweden	10		1
Finland	5		1
Spain	40		1
Portugal	15		1
Other Western Europe	90		3
Japan	230		8
Australia	60		2
Eastern Bloc	375		13
Other	200		7
<b>Total</b>	<b>2925</b>		<b>100</b>

SOURCE: UNIDO, Vienna

ANNEX II (b)

World Use of Pesticides by Groups

Country	% total use in each area		
	Herbicides	Insecticides	Fungicides
N. America	61	25	7
W. Europe	49	25	23
Far East	25	45	21
Africa	31	42	28
S. America	30	53	16
Australia and N.A.	45	38	16
C. America and Caribbean	33	51	15

SOURCE: UNIDO, Vienna



Cost per lb. of commonly used insecticides

Compound (technical product unformulated)	Price \$/lb
Aldrin	0.992
Dieldrin	1.665
DDT	0.179
Heptachlor	0.973
Malathion	0.900
Parathion	0.780
Lindane	1.406
Chlordane	0.602
Endrin	2.469
Dichlorvos	3.750

SOURCE: UNIDO, Vienna

ANNEX II (d)

CONSUMPTION TRENDS OF DIFFERENT CATEGORIES OF PESTICIDES IN DEVELOPING COUNTRIES

A . T . L I N 1000 T O N S .

COUNTRIES	1970		1972		1975*		1978†		1980†		
	Tons	Percentage	Tons	Percentage	Tons	Percentage	Tons	Percentage	Tons	Percentage	
BRASIL	Insecticides:	29.771	72%	38.901	57%	58.72	55%	57.00	55%	72.50	50%
	Fungicides:	7.765	19%	24.304	36%	11.59	11%	53.80	42%	65.12	45%
	Herbicides:	3.429	9%	4.750	7%	7.60	7%	1.10	5%	11.10	5%
	Others:	---	---	---	---	---	---	---	---	---	---
HUNGARY	Insecticides:	2.772	15%	2.900	12%	3.690	11.2%	4.420	11.6%	5.500	12%
	Fungicides:	10.447	57%	12.380	51%	15.820	45%	15.210	40%	12.500	37%
	Herbicides:	4.684	25%	7.280	41%	10.820	33%	13.320	35%	16.300	37%
	Others:	0.421	2.5%	1.510	6%	4.220	13%	4.370	13.4%	6.200	14%
INDIA	Insecticides:	18.210	70%	24.355	69%	35.074	70%	48.505	70%	56.000	69%
	Fungicides:	7.100	27%	9.236	26%	11.267	22%	14.210	21%	15.462	19%
	Herbicides:	0.520	2%	0.980	2.8%	1.880	3.8%	4.440	6.4%	6.250	7.7%
	Others:	0.260	1%	0.600	1.7%	1.070	2.1%	1.880	2.7%	2.712	3.8%
POLYLA.	Insecticides:	12.640	80%	14.420	80%	18.230	52%	20.610	49%	21.000	46%
	Fungicides:	---	---	---	---	13.200	32%	17.120	34%	21.460	37%
	Herbicides:	2.630	19%	3.610	19%	6.500	16%	13.312	16%	18.230	16%
	Others:	---	---	---	---	0.150	0.5%	0.820	1%	1.265	1%

\* Projected Values.

SOURCE: UNIDO, Vienna

PESTICIDES - CONSUMPTION TRENDS IN DEVELOPING COUNTRIES.

A L L I N 1 0 0 0 T O N S .

COUNTRIES	1965	1968	1970	1972	1975 -X-	1977 -X-	1980 -X-
<u>B R A Z I L</u> ::	22.292	35.943	47.211	69.232	100.955	120.203	145.000
<u>H U N G A R Y</u> ::	22.535	17.209	18.321	24.320	32.610	42.832	44.500
<u>I D C A S</u> ::	35.000	48.200	56.000	61.800	70.000	77.800	88.000
<u>I N D I A</u> ::	12.670	16.078	26.000	35.161	60.000	52.962	81.200
<u>I R A N</u> ::	-----	3.797	4.122	10.201	16.500	21.375	28.000
<u>R O M A N I A .</u> ::	9.755	12.210	13.290	24.872	38.085	46.231	62.775

- X - Projected values for future is given by the competent planning bodies of concerned countries or found by the growth rate trend from the immediate past years.

SOURCE: UNIDO, Vienna

Chemical raw materials availability for pesticides production in some  
developing countries of ESCAP region

N/N	Country	Current and potential basic raw materials for pesticides production
1	Thailand	chlorine, ethanol, turpentine, copper
2	Indonesia	chlorine, benzene, ethanol, carbon disulphide, sulphuric acid, copper, manganese, pyrethrum, sulphur
3	Philippines	chlorine, copper, ethanol
4	Malaysia	chlorine
5	Nepal	pyrethrum
6	India	chlorine, benzene, ethanol, methanol, dichloroacetamide, copper, sulfuric acid, hydrochloric acid, monochloroacetic acid, para toluene sulfonic acid, nickel, aluminium, phosphorous, zinc, phenol, camphene, sodium hydroxide, sodium cyanide, sodium methoxide.

RAW MATERIALS NEEDED FOR IMPORTANT PESTICIDES ALREADY POPULAR INESCAP REGION

<u>Name of the Insecticide</u>	<u>Main raw Materials</u>
1. BHC	1. Benzene 2. Chlorine
2. DDT	1. Chloral 2. Chlorobenzene
3. PHOSPHAMIDON	1. Dichloroacetamide 2. Trimethyl Phosphite
4. DDVP	1. Chloral 2. Trimethyl Phosphite
5. COPPER SULFATE	1. Copper 2. Sulfuric Acid
6. COPPER OXYCHLORIDE	1. Copper 2. Hydrochloric Acid
7. NICKEL CHLORIDE	1. Nickel 2. Hydrochloric Acid
8. 2, 4-D-ACID	1. 2, 4-Dichloro phenol 2. Monochloroacetic Acid
9. ALUMINIUM PHOSPHIDE	1. Aluminium 2. Phosphorous Fd
10. ZINC PHOSPHIDE	1. Zinc Fowder 2. Red Phosphorous
11. THIRAM	1. Carbon Disulfide 2. Dimethyl Amine 3. Sod. Hydroxide
12. ZIRAM	1. Carbon Disulfide 2. Dimethyl Amine 3. Zinc chloride 4. Sod. Hydroxide
13. THIOCARBAMATE	1. Carbon disulfide 2. Ethlene diamine 3. Zinc chloride 4. Sod. Hydroxide
14.. ENDRIN	1. Cyclopentadiene 2. Hexachlorocyclppentadiene 3. Vinyl chloride
15. ALDRIN	1. Cyclo Pentadiene 2. Acetylene 3. Hexachlorocyclopentadiene

<u>Name of the Insecticide</u>	<u>Main Raw Materials</u>
16. CHLORDANE	1. Cyclo Pentadiene 2. Hexachlorocyclopentadiene 3. Chlorine
17. TOXAPHENE	1. Camphene 2. Chlorine
18. PHORATE	1. Phosphorous Pentasulfide 2. Ethanol 3. Formaldehyde 4. Ethyl Mercaptan
19. PHENTHOATE	1. L. Bromo Phenyl Acetic Acid 2. Ethanol 3. Methanol 4. Phos. Pentasulfide
20. TETRADIFON	1. 2,4,5-Trichloro Phenyl Sulfonyl Chloride 2. Chlorobenzene
21. DICOPOL	1. DDT 2. Chlorine 3. Sulfuric acid 4. Para Toluene sulfonic acid
22. CARBAMATE	Napthol Methylamine Phosgene or MIC
23. CARBOFURAI	MIC Catechol Methallyl chloride
24. ENDOSULFAN	Hexachlorocyclopentadiene 1,4-Butene-Diol Thionyl Chloride
25. FALAQAT	Sodium Cyanide Pyridine Methyl Chloride
26. FURADAN	Catechol Methyl Isocyanate Methallyl chloride Chloroform Methyl alcohol Sodium Methoxide
27. E. PARATHION	p-Nitrophenol Phosphorus Trichloride
28. M. PARATHION	p-Nitrophenol Phosphorus Trichloride

Name of the Insecticide

Main Raw Materials

29. DIMETHOATE

Phosphorus Pentasulphide  
Monomethyl Amine

30. FENITHOTHION

Phosphorus Trichloride  
p-Nitro Meta Cresol  
Phosphorus Pentasulphide

31. KALATHION

Phosphorus Pentasulphide  
Maleic Anhydride

32. METHYL DEMETON 50% Conc.

p-Nitro Meta Cresol  
Thio alcohol

Experience of Brazil in pesticides industries development

Agricultural growth in Brazil is quite pronounced. It increased 6 per cent in 1969, 9 per cent in 1970 and 11.4 per cent in 1971. As a result, the market for imported and locally produced pesticides has grown steadily. The consumption of pesticides increased from 16,000 tons in 1963 to 68,000 tons in 1972, with only 28 per cent of the cultivated area receiving pesticide treatment.

To promote the use of pesticides, the Government extends a series of facilities such as assistance to farmers in the way of minimum prices, crop-term credits, tax rebates and duty-free imports to manufacturers, scientific and technical support of research on new products in co-operation with international organizations. The pesticide industry provides guidance on the use of products and the development of indigenous production. Progress on the latter is, however, slow and not completely satisfactory. Manufacturers abroad have not responded to the potential market in Brazil.

The value of pesticide imports increased three- to fourfold between 1963 and 1972. The tonnage of imports and local production in 1972 was as follows:

	<u>Imports</u>	<u>Local production</u>
Insecticides	24,896	14,025
Fungicides	20,054	4,250
Herbicides	4,750	nil

Domestic production, which totalled 18,275 tons in 1972 was confined to DDT, BHC, ethyl and methyl parathion and maneb. Bridging the gap between local manufacture and the country's demand is an important objective of the Government, although it is realized that not all the

/chemical



chemical inputs are available locally and that there is a shortage of technically trained personnel. The organic petrochemical industry is, however, growing at a very fast rate. The following factors are significant indications of the trend:

- (a) DDT and BHC represent about 80 per cent of the local production with additional DDT imported for public-health application, that is to combat malaria;
- (b) The demand for fungicides has increased rapidly (400 per cent in tonnage between 1963 and 1972). Copper oxychloride is the dominant fungicide;
- (c) The sale of organophosphate compounds increased from 10 per cent of the total in 1963 to 20 per cent in 1972;
- (d) The sale of herbicides increased from 1.8 per cent of the total market in 1963 to 6.9 per cent in 1972;
- (e) Although more than 20 herbicides are imported, 38 per cent of the total was 2, 4-D. The value of the estimated annual sales for the projected local manufacture of 2, 4-D is \$1.3 million.

(Source: Report of the Workshop on Pesticides, Vienna, May/June 1973).

A) INDIA: FACTORS THAT PROMPTED FARMERS TO START USING PESTICIDES  
(% of users mentioning each factor in 1964/65)

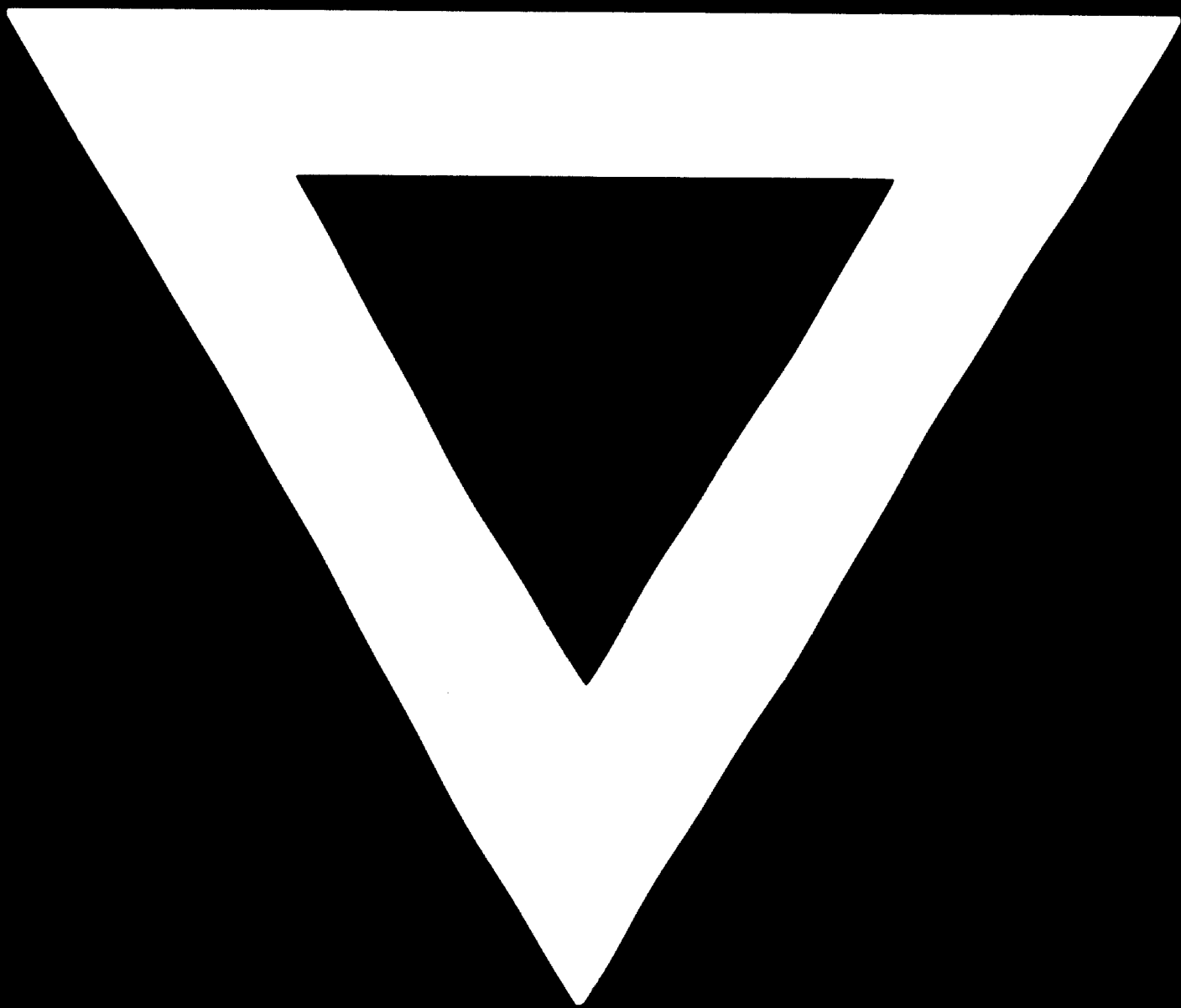
State	Agricultural extension workers	Demonstrations	Suggestion of friends	Other factors
Andhra Pradesh	83	63	13	-
Madras	59	63	27	6
Mysore	95	71	54	26
Maharashtra	3	47	71	21
Punjab	100	100	-	-
Uttar Pradesh	78	52	19	13

Source: Pesticides in Indian Agriculture. National Council of Applied Economic Research, New Delhi, 1967.

B) INDIA: REASONS GIVEN BY FARMERS IN 1964/65 FOR NOT USING PESTICIDES  
(% of users mentioning each reason)

State	Not aware of pesticides and their efficacy	Do not have enough financial resources	Not aware of pest attack
Andhra Pradesh	52	64	-
Madras	37	39	3
Mysore	42	62	14
Maharashtra	75	48	14
Punjab	64	7	-
Uttar Pradesh	55	34	38

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**77.06.27**