WHO-ROHC SPONSORED TRAINING PROGRAMME ON

OCCUPATIONAL HEALTH IN AGRICULTURAL SECTOR

8[TH] TO 12[TH] FEBRUARY 1999

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INDIAN COUNCIL OF MEDICAL RESEARCH

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PROGRAMME

DAY –1 : 8TH FEBRUARY 1999 (MONDAY)

9.00 Hrs. **REGISTRATION**
10.00 Hrs. **INAUGURATION**
11.00 Hrs. TEA

TIME	LECTURE	FACULTY
11.30 Hrs.	Occupational Health Problems of Agricultural Workers in India-An Overview	DR. H. N. SAIYED
12.15 Hrs.	Clinical Approach to Occupational Asthma	DR. A. OMPRAKASH
13.00 Hrs.	LUNCH	
14.00 Hrs.	Occupational Health Aspects In Sericulture	DR. S.B. DANDIN
14.45 -17.30 Hrs.	Field Trip To Sericulture Farm, Talaghattapura, Bangalore	

DAY –2 : 9TH FEBRUARY 1999 (TUESDAY)

TIME	LECTURE	FACULTY
9.30 Hrs.	Silicosis and Silico-Tuberculosis In Rural Industry	DR. H.N. SAIYED
10.15 Hrs.	Toxic Lung Injury	DR. D.P. NAG
11.00 Hrs.	TEA	
11.30 Hrs.	Tuberculosis Among Agricultural Workers	DR (MRS.) P. JAGOTA
12.15 Hrs.	Ergonomic Practices In Agricultural Processes	DR. P. K. NAG
13.00 Hrs.	LUNCH	
14.00-17.00 Hrs	Field Trip To M/s. Mysore Agro Feeds & M/s. Gayathri Flour Mills, Bangalore	

DAY –3 : 10TH FEBRUARY 1999 (WEDNESDAY)

TIME	LECTURE	FACULTY
9.30 Hrs.	Pesticide Residues In Food Chain And Their Impact	DR. M.D. AWASTHI
10.15 Hrs.	Pesticide Related Health Problems	DR.(MRS.)S. KULSRESTHA
11.00 Hrs.	TEA	
11.30 Hrs.	Pesticides And Human Health	DR . D.P. NAG
12.15 Hrs.	Cancer Scenario in rural India With A Brief Review of Cancers In Farm And Agricultural Workers	DR. A. NANDAKUMAR
13.00 Hrs.	LUNCH	
14.00 Hrs.	Challenges Of Agricultural Medicine For PHC Doctors	DR. RAVINARAYAN
14.45 Hrs.	Change In Trends In Alcoholism	DR. G.S. PALAKSHA
15.30 Hrs.	TEA	
16.00 Hrs.	Care Of Surgical Wound In Industrial Set-up	DR. FRED SIMON OOMON

P.T.O

DAY –4 : 11TH FEBRUARY 1999 (THURSDAY)

TIME	LECTURE	FACULTY
9.30 Hrs.	Veterinary Zoonosis	DR. R. RAGHAVAN
10.15 Hrs.	Occupational Health Problems Among Poultry Workers	DR.R.N.SRINIVASA GOWDA
11.00 Hrs.	TEA	
11.30 Hrs.	Occupational Health Hazards Among Dairy Workers	DR. M.N. KAILASH
12.15 Hrs.	Health Hazards Among Small Laboratory Animal Workers	DR. B.R. SRINATH
13.00 Hrs.	LUNCH	
14.00-17.00 Hrs	Field Trip To Bangalore Dairy	

DAY –5 : 12TH FEBRUARY 1999 (FRIDAY)

TIME	LECTURE	FACULTY
9.30 Hrs.	Causation of Work Environment And Chemically Induced Cardiac Diseases	DR. U.B. KHANOLKAR
10.15 Hrs.	Overview of Occupational Health And Safety	DR. RADHAKRISHNA
11.00 Hrs.	TEA	
11.30 Hrs.	Industrial Hygiene Survey In Coir, Agarbathi And Tea Industry	DR. V.KRISHNA MURTHY
12.15 Hrs.	Health Hazards Of Workers Engaged In Coir, Agrabathi And Tea Industry	DR. H.R. RAJMOHAN
13.00 Hrs.	LUNCH	
14.00-16.00 Hrs	Evaluation Of The Programme And Recommendations	

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REGIONAL OCCUPATIONAL HEALTH CENTRE (SOUTHERN)
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Occupational Health Problems of Agricultural Workers in India - An Overview

DR. H. N.SAIYED
Director, National Institute of Occupational Health, Meghani Nagar, Ahmedabad-380 016, Gujarat.

Contribution of Agriculture to Indian Economy

The Green Revolution has changed the face of Indian agriculture since Independence. Food grain production, which stood at a mere 50 million tonnes at Independence, has increased nearly four times by the end of 1996-97 crop year. Latest estimates for 1996-97 put the total food grain production at an all time high of 198.17 million tonnes.

Post Independence farming has been marked by crop diversification. New crops like soyabean and sunflower are being adopted increasingly by farmers. As a result of intensive dissemination of information on new methods of farming, farmers are now using more inputs and technology resulting in diversification of and an increase in cropping intensity. Today many crops are planted and cereals are grown in rotation with horticulture instead of a single crop annually.

Employment in Agriculture Sector

Agriculture sector remains primary source of employment in India. As per 1991 Census[1], the working population of India was 278.9 million (34.17%) out of total population of 816 million. Out of this 278.9 million workers, 186.2 million (66.7%) were engaged in various agriculture related operations such as farming, live stock, forestry, fishing, hunting etc (Table 1). The proportion of individuals engaged in agricultural operations is much higher in India than that in the industrialized nations. For example, in U.S.A. only about 2% of the total population is engaged in agriculture related operations and in most of West European countries it is less than 10%. Further analysis of 1991 Census data reveals that amongst farmers (180.9 million or 64.9% of the total working population), about 131 million were men and about 50 million were women. It may be noted with concern that 34.7% men and 56.8% women farmers were working as agricultural labourer (Table-2). According to Census, an "agriculture labourer" is a person who works on another person's land for wages in money or kind or share. He (or she) does not have right of lease or contract on land on which he (or she) works.

Year wise analysis of employment in agriculture sector indicate that the number of people engaged in agriculture operations (excluding those engaged in live stock, forestry, fishing, hunting etc) has increased from 125 million in 1971 to about 180.9 million in 1991. However, the percentage of total employment in agriculture sector amongst men has decreased from 67.5% in 1971 to 60.7% in 1991(Table-3). In women workers this figure has changed very little and has remained around 80%. In other words, amongst women folk there are not much change in the pattern of employment.

Table 1 : Distribution of working and non-working population by Industry division. (Census, 1991)

	Men		Women		Total	
	No.	%	No.	%	No.	%
Cultivation	85.6	39.63	21.5	34.18	107.1	38.40
Agricultural labour	45.5	21.06	28.3	44.99	73.8	26.46
Live stock, forestry, fishing	4.3	1.99	1.0	1.59	5.3	1.90
Agricultural operations	135.4	62.69	50.8	80.76	186.2	66.76
Non agricultural operations	1.5	0.69	0.2	0.32	1.7	0.61
Total main working	216	100.0	62.9	100.00	278.9	100.00
Total population	**423.6**	**100**	**392.6**	**100**	**816.2**	**100**

Table 2 : Distribution of cultivators versus agricultural labourers

	Men	Women	Total
Cultivators	85.6 (65.29)	21.5 (43.17)	107.1(59.20)
Agriculture labourer	45.5 (34.70)	28.3 (56.82)	73.8(40.79)
Total farmers	**131.1**	**49.8**	**180.9**

Table 3 : Sex wise employment in agriculture (farming only) and non-agriculture sector in India (in million)

Year	Men		Women	
	Agricultural	Non-	Agricultural	Non-
1971	100.66(67.49)	48.49 (32.51)	25.10	6.24 (19.91)
1981	112.33	65.22 (36.63)	35.70	9.28 (20.62)
1991	131.09	84.93 (39.31)	49.80	13.12 (20.85)

Major Occupational Health Problems of Agricultural Workers

The Indian farmers, like those of other third world countries, have many social and health problems. The housing and sanitation are generally very poor and predisposes to infectious diseases such as malaria, filaria, diarrheal diseases, typhoid, worm infestations, hepatitis etc. The poor economic conditions lead to the problem of malnutrition. This results in a vicious circle of lower output, decreased income, poor socio-economic status, poor health and so on. Studies in India[2] have shown that if a person with inadequate diet is given 20 percent increase in the calories it results in 50 percent increased work capacity and output.

Over the past three decades there have been remarkable changes in the agriculture practices. Mechanization of various agriculture operations has been introduced. There is increasing use of chemicals such as chemical fertilizers and pesticides. These modified agriculture practices have introduced newer occupational health problems. The major occupational health problems of farmers are pesticide exposure, accidents and ergonomic problems, exposure to various biological agents, extreme climatic conditions etc. Creation of industrial estates near the agriculture land has lead to problems due to industrial effluents to neighbourhood farmers.

In following paragraphs some of the occupational health problems of Indian farmers along with studies carried out by National Institute of Occupational Health (NIOH) have been discussed.

Pesticide Exposure Related Problems

Following tragic famine of Bengal in 1941-42, the Government of India appointed a commission called, Indian Famine Enquiry Commission to investigate the causes of famine and suggest suitable action. The Commission concluded, "If full benefits of irrigation, manuring and improved varieties are to be assured, effective action must be taken to deal with the diseases, pests, worms and weeds, crop protection is an important factor in increasing production."[3]

DDT and BHC were introduced in India, in 1948-49 for public health and agricultural use. Since then, some new pesticides are introduced every year and today there are 143 pesticides registered for use in the country under section 9(3) of the Insecticide Act, 1968. The consumption of technical grade pesticides today in India is about 81,000 MT of which about 80% is used in agriculture and remaining 20% is used for public health purpose and the use would increase to 1,18,000 MT per annum by 2,000 A.D.[4] The turn over of pesticide business in India in 1993-94,1994-95 and 1995-96 was 18,750, 22,500 and 27,000 million rupees respectively.

Injudicious and indiscriminate use of chemical pesticides has resulted in

- Health hazards to human beings from direct or indirect exposure to pesticides.
- Development of resistance in pests to pesticides leading to a vicious cycle of use of greater dose leading emergence of new resistant species and pest resurgence due to destruction of natural enemies.

- Pesticide residues in food, water, soil and fodder.
- Poisoning of wildlife and livestock.
- Environmental pollution.
- Ecological imbalance.

Health Hazards to Human beings from Direct or Indirect Exposure to Pesticides.

The basic metabolic processes at cellular or sub-cellular level is similar in all living organisms and therefore adverse effects of the chemical pesticides are always expected in non-target organisms including human-beings. Persons most likely to be affected are those with direct contact i.e. people who are involved in manufacture, formulation and use or application of pesticides. Use of pesticides at any stage of food production can lead to exposure of general population. The problem would naturally be more serious with pesticides like organochlorine compounds, which are persistent in nature and capable of undergoing bio-magnification. NIOH has carried out studies related to acute health effects resulting from exposure to pesticides following its spray. Some of these studies have been described below.

- **Effects of ultra low volume (ULV) aerial spray of phosphomidon (OP insecticide) on human volunteers : A field study[5]**

  Toxicological effects of ultra low volume aerial spray of phosphamidon, a highly toxic organophosphorus insecticide, were evaluated in volunteers. A single ULV aerial application of phosphamidon in doses of 550 g/ha produced irritation of eyes and conjunctiva in majority of exposed persons at the time of insecticide application. Plasma cholinesterase activity was 75% of the pre-exposure value on the third day following exposure. No significant reduction in RBC cholinesterase activity was observed. On the basis of observation it was recommended that the aerial spray should not be repeated in the same area within few weeks period to avoid cumulative effects among exposed subjects.

- **Cardiac toxicity following short-term exposure to methomyl in spraymen and rabbits[6]**

  Methomyl, a carbamate insecticide, is used as an insecticide since 1966 in USA, particularly for the control of lepidopterous insects in crops including fruits, vines, hops, vegetables, grains, soya beans, cotton, sweet corn and ornamentals. Its indoor uses include the control of flies in animal houses and dairies. It was introduced in India for the control of bollworm in cotton in

Andhra Pradesh. Soon after its introduction, there were news about alleged deaths and toxicity amongst the applicators. To investigate the toxicity of methomyl, a short-term study was carried out by National Institute of Occupational Health at the request of the Ministry of Agriculture, Government of India. The study consisted of two components, (a). Human study and (b). Experimental study in rabbits.

- **Human study**

  The study group comprised of 22 healthy male agriculture workers, aged between 18 and 42 years, who had not sprayed any kind of pesticides at least one month before the beginning of the study. The guidelines laid down by the ethical committee of the institute for medical studies involving human exposure was strictly followed. These subjects sprayed methomyl in a large cotton farm for 5 days using prescribed concentration. The spraying schedule was carried out under medical supervision. The spraymen were neither allowed to smoke or to eat during 4 hours of spray. They used protective gloves, overall, goggles and mask.

  All the study subjects underwent thorough medical examination including electrocardiography (ECG), estimation of cholinesterase (ChE), serum glutamic oxalo-acetic transaminase (SGOT) and lactate dehydrogenase (LDH) before exposure, at the end of the 5 days exposure and one-week after cessation of exposure. Significant changes were observed in ECG and levels of ChE and LDH. Major ECG abnormality was changes in the T wave observed in 10 (45.4%) subjects. These changes included diminution in height of T wave, T wave inversion and significant left ward deviation of its frontal plane axis. These changes correlated with post exposure rise in LDH levels indicating possible cardio-toxic effect of methomyl.

- **Study in rabbits**

  As the above-mentioned ECG findings were reported for the first time, it was necessary to verify these findings through experimental studies. A pilot experimental study was performed in four rabbits. Methomyl was given at dose of 4 mg Kg^{-1} body weight on first day and 5 mg Kg^{-1} body weight on second day. Three out of four rabbits showed the same ECG changes as observed in spraymen. The depth of T wave inversion increased on the next day following higher dosages. These findings confirmed the cardiac toxicity of methomyl observed in spraymen.

Our recent study in workers engaged in formulation of methomyl, showed a significant rise in the levels of lactate dehydrogenase (LDH), alpha hydroxybutarate dehydrogenase (HBDH), and glutamate pyruvate transaminase (GPT) enzymes after a week's exposure. Rise in these enzymes indicates possible cardio-toxic effects of methomyl in these workers.

Comprehensive data on long term effects such as teratogenic, mutagenic and carcinogenic potentialities of these chemicals are usually not available. Even short-term unusual effects may be discovered long time after its introduction. Many of these pesticides enter into the food chain and may even undergo bio-magnification thus affecting the consumers, which includes the more vulnerable group such as children, pregnant women and old and sick persons.

Recently there has been greater concern over the endocrine disrupting effects of many persistent pesticides belonging mainly to organochlorine group of insecticides has been expressed. More and more direct evidence is accumulating indicating endocrine effects of pesticides on aquatic animal and plant life, birds and reptiles. There are indications of possibility of such effects on human beings.

Ergonomic Problems of Farmers

Large numbers of Indian farmers continue to use traditional tools such as hoes, sickles, manual weeders etc. These tools are designed by the local artisans. There is great scope for improving design of these basic tools to make them more efficient and safe. NIOH scientists have carried out some research projects related to this aspect some of them have been summarized below.

Ergonomics in the hoeing operation[7]

Hoe is a basic tool in agriculture, civil construction and forestry. A study was undertaken by the NIOH scientists, in seven male farmers using two types of hoes (A & B), to evaluate physiological and biomechanical strains in using different sizes of hoes and to optimize hoeing tasks in different models. The heart rates (161 – 176 beats/min.) and VO_2 demands (71 – 89% $VO_{2\ max.}$) indicated extremely heavy work loads. Hoe A (blade handle angle = 65°) was less strenuous in low lift (LL), while hoe B (blade handle angle = 87°) was better in high lift (HL) work. During hoeing sequence, the torque and compressive forces at the L5 – S1 increased with trunk inclination upto 65°; beyond 55° inclination, the torque at the L5 - S1 exceeded the upper limit 155 nM allowed for a day's work. The work output was optimized equating at 50% $VO_{2\ max}$. i.e. stroke rate 53 and 21 strokes/min., weight of soil dug = 123 and 54 kg/min. and area of soil dug =1.34 and 0.33 Sq. M/min. in LL and HL work respectively. In general farmers are suggested to adopt the LL mode of hoeing; with a ten-minute work to seven-min. rest ratio.

- **Ergonomics in sickle operation[8]**

In India, although mechanization of harvesting operation has been introduced in some parts of the country, the use of sickle still continue. It has been realized that ergonomics has immense potential in achieving better performance in farm task. There is lack of qualitative and quantitative information on the application of ergonomics to the evaluation of relative performance of different sickles on some common crops. A study was designed to compare different models of sickles traditionally used and to specify the design characteristics of a sickle, which have influence on human comfort, efficiency and safety. Sickle operation in harvesting was analysed with reference to design features of nine different types of sickles, and field and laboratory based investigations on biomechanical stresses and physiological valuation on six farmers. The study results indicated that the blade geometry contributes significantly to human performances and there is ample scope for further design optimization. The suggested modifications were (1) sickle weight - 200 g; (2) total length of sickle - 33 cm; (3) handle length - 11 cm.; (4) handle diameter - 3 cm.; (5) radius of blade curvature - 15cm .; (6) blade concavity - 5 cm; (7) in case of serrated sickle, tooth pitch - 0.20 cm and tooth angle 60°; (8) ratio of cutting surface to cord length - 1.20.

Occupational Health Problems of Agricultural Workers in India - An Overview

- **Physiological reactions of women workers engaged in Indian agricultural work[9]**

Physiological measurements in women agricultural labourers have four practical applications :

- To provide a basis for nutritional counseling of the individual worker for the purpose of metabolic balance and growth maintenance during normal life, pregnancy and lactation.
- To judge the suitability of tasks for the individual worker and to match the worker to the job and vice versa.
- Where appropriate to encourage some form of restful rather than active recreation in order to reduce taxing of the body and
- To develop guidelines for tasks involved agricultural work over the total work shift in different environmental conditions for providing better working conditions so as to minimize the possible fatigue of workers.

The physiological reactions of eight women workers in agricultural tasks and leisure time activities were determined with a view to standardize occupational workload. A majority of the tasks performed by the workers were within 33% of $VO_{2\ max.}$ but some of the jobs classified as moderate and heavy required 39% to 55% of $VO_{2\ max.}$ None of the agricultural task could be considered extremely heavy. The whole day energy expenditure of these

workers was estimated to be 1061 MJ or 450 KJ less than their total energy intake. About 52% of this energy were required for the day's work and remainder was expended for the maintenance of postures and other activities. On the basis of the study it was suggested that the workers may be allowed to work up to the limit of 40% $VO_{2\ max.}$ for longer duration, if an increase in productivity was desired.

- **Effectiveness of some simple agricultural weeders with reference to physiological responses[10]**

  Seven different types of weeders, namely (1) double sweep-type (2) projection finger- type (3) single raw multiple sweep-type (4) blade and rack-type (5) wheel and hoe-type (6) single sweep wheel-type and (7) triple sweep wheel-type were studied with reference to physiological responses and are weeded per unit time by using each method, and manual weeding. Five young skilled agricultural workers were used for the study. Average work pulse rate varied from 105 to 120 beats/min. in weeding operations using blade and rack-type, projection finger-type and double sweep-type weeders. The lowest cardiac response was observed with wheel and hoe-type weeder. Blood pressure responses were also higher with other three weeders mentioned above. Pulmonary demand was around 27 L/min. with all the weeders; but the highest oxygen uptake (56% of the maximal oxygen uptake) occurred in case of a projection finger-type weeder. The maximum area was weeded (1.42 sq./min.) by the wheel and hoe- type weeder. Comparing physiological demand, preference of workers and work performance, the wheel and hoe-type of weeder was found to be best suited for Indian conditions.

Studies on Occupational Health Problems in Agricultural Tobacco Workers

India is the third largest tobacco growing country in the world producing about 8% of the total world tobacco production. There are about 7 lakh workers engaged in growing of tobacco and about 5 lakh workers engaged in curing of it. Andhra Pradesh and Gujarat are two major tobacco-growing states in the country responsible for about 80% of the tobacco grown in the country. Weizencker and Deal[11] described the first report on the symptom complex known as "green tobacco sickness". The "green tobacco sickness" consists of headache, nausea, vomiting, giddiness, weakness and fatigue and fluctuation in blood pressure and heart rate. The condition is self limiting and lasts for few hours. It believed to be caused by absorption of nicotine through skin. The presence of "green tobacco sickness" in the Indian tobacco cultivators was described by NIOH scientists[12] in non-Virginia tobacco growers of Gujarat. Subsequently the same condition was described in the Virginia tobacco growers of Andhra Pradesh[13]. It was demonstrated in both the studies that there was significant absorption of nicotine as evidenced from high levels of nicotine and its major metabolite, cotinine in the urine.

To prevent absorption of nicotine and subsequent occurrence of "green tobacco symptoms, NIOH scientists made trial with cotton and rubber gloves in 100 tobacco cultivators who reported to suffer from "green tobacco sickness". It was found that the use of rubber gloves offered protection and the alleviation of symptoms was reported by about 93% of the subjects. There was also significant reduction in excretion of nicotine and cotinine in urine[14]. However, the gloves could not be made popular because they were found to be expensive and could not be re-used after washing. At present NIOH scientists are making trial with disposable polyethylene rubber gloves which are very cheap, affordable and effective.

Summary and Conclusions

Agriculture industry continues to be the principal source of employment in India. Changes in agricultural practices have helped in achieving food production targets and have virtually eliminated the risk of famine, which was not uncommon during pre-independence year. However, the Indian farmers in addition to their traditional health problems such as malnutrition, infectious diseases etc. are exposed to a number of hazards such as exposure to chemicals, toxic plant products and ergonomic problems resulting from change in the agricultural practices. Injudicious use of pesticides has resulted in occupational and environmental health problems and ecological imbalance. The acute effects of the chemical pesticides are very well known, however, their chronic health effects, such as carcinogenic effects, teratogenic effects, mutagenic effects etc., resulting from repeated low dose exposure have not understood fully. There is greater use of persistent pesticides such as DDT, BHC, endosulfan etc. Injudicious and indiscriminate use of chemical pesticides has resulted in health hazards to man, development of resistance in pests to pesticides leading to a vicious cycle of use of greater dose resulting in emergence of new resistant species and pest resurgence due to destruction of natural enemies, pesticide residues in food, water, soil and fodder, poisoning of wild-life and live stock and ecological imbalance. Large number of Indian farmers continues to use traditional tools such as hoes, sickles, manual weeders etc. These tools are designed by the local artisans. There is great scope for improving design of these basic tools to make them more efficient and safe. The farmers need to be educated about the hazards involved in using the newer technique and the methods of the prevention.

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Clinical Approach To Occupational Asthma

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Occupational asthma is being reported, elucidated and increasingly appreciated in recent years. Progressive industrialisation in the global context is exposing workers to a variety of potentially allergenic substances at work. Consequently, it is not surprising that an ever increasing number of cases of occupational asthma is being reported. The accurate diagnosis of occupational asthma is crucial from many points of view. As early as in 18th century, Ramazzini recognized that workers sifting grains developed cough and wheezing; is rightly called the father of occupational medicine as he encouraged his students to add work history to the other points elicited. Occupational Asthma (OA) can be defined as variable air flow limitation and air way hyper-sensitiveness due to causes attributable to the work place. OA can be caused by both allergic and non-allergic causes. The prevalence of OA is very variable as reported from different parts of the world. This variation is due to many factors including the nature of the allergen, diagnostic criteria etc. In fact, within a given industry varying prevalence rates are often noted. Another confounding factor would the so-called "healthy worker effect" wherein the worker with OA leaves the occupation due to increasing illness. Consequently one has to describe prevalence rates in relation to a given industry at a given point of time. Over the past 50 years, more than 200 agents have been shown to be capable of causing occupation-related asthma. In the initial years it was felt that high molecular weight glycoproteins were the main causes; in recent years it has been demonstrated adequately that low molecular weight substances also can cause this syndrome by acting as haptens. Depending on the allergen involved prevalence rates of OA have varied from as low as 2% too as high as 30% in various studies. For instance, Western Red cedar workers have a prevalence of 5% while acid anhydrides can cause OA in about 20% of workers.

Mechanisms

Several mechanisms are implicated in the causation of OA. These include both immunology and non-immunology mechanisms. The latter mechanisms include the following:

a) Stimulation of irritant receptors by toxic or irritant substances (e.g. plicatic acid)
b) Activation of serum complement by classical or alternate pathway (e.g. Western red cedar)
c) Direct pharmacological effect (e.g. TDI)

Most of the immune mediated OA is due to IgE mechanisms. The role of proteins, glycoproteins and polysaccharides in the causation of OA in various situations has been abundantly demonstrated. In recent years it is known that several agents which are low molecular weight substances can act as haptens and induce allergenicity by combining with serum proteins. In some cases the possible role of IgG4 is being investigated in recent years.

Evaluation of OA from the clinical view point

The evaluation of a subject possibly suffering from OA begins when the clinical suspicion is raised by primary care physician that a given case of asthma may indeed be due to an occupational exposure. In such a case, a series of systematic steps have to be taken to establish the causal relationships between the occupational offending agent and the subject's asthma.

History

A comprehensive and careful history has to be elicited whether there is a sufficient possibility that a given case is one of OA. Workers are often unaware of the substances that they are exposed to and therefore the clinician has to visit the workplace and observe the work environment in a critical fashion with a discerning eye. The factory managers and factory Medical Officer can provide invaluable information as to the possible agents that can cause OA. These agents have to be documented. In our country, there is lack of industrial hygienists that can provide a lot of help in this regard. Consequently, the clinician has to do a substantial amount of study of the literature to know whether a given substance has been already documented as a cause of OA. In cases where no such information is available, the task becomes more formidable and challenging.

A careful history and workplace survey will often will be very helpful in narrowing down the possibility of causal agents. In case the OA is suspected in a non factory environment (such as an industry which is community based both in the governmental and private sectors), an epidemiological study is needed in the suspected worker population as well as a control population; such a study will afford important information to the clinical research worker that indeed there is a higher prevalence of asthma in the occupation related population.

After documenting these data, the clinician proceeds with the further and important history elicitation to whether the asthma is likely to be due to the agent at the work environment. In this context it is important to realize that the period needed to sensitize the individual to a given occupational allergen may vary enormously. This latent period can be few months (e.g. platinum salts), about 2 years (e.g. DTI), 4-5 years (e.g. colophon) and over ten years (e.g., silk allergens) factory workers rendering clinical analysis more complex.

While eliciting history, it is also necessary to enquire about possible exposure to allergens at places other than the work situations (secondary occupation or at home) as well as due to some hobby being pursued by the subject. Location of a known strong sensitizes in close proximity has also to be looked into; it is known that people living very close to factory where DTI is used may get sensitized and develop disease in due course of time due to "secondary exposure". In the clinical context, it has to be understood that the clinical patterns of asthma are variable. These include the immediate asthmatic response, the delayed response, the dual asthmatic response as well as recurrent (often-nocturnal) asthma after a single exposure to the offending substance. This makes the clinical diagnosis of OA more difficult as there is no definite temporal sequence, which is usually associated with the occurrence of allergic responses.

Lung Function Tests

Estimation of PEFR and FVC and FEV1.0 are commonly used in the context of OA. Apart from base line measurements one has to perform serial measurements of these parameters while the subject is at work. PEFR records both at work and at home frequently may provide valuable information. More important would be the "off and on " measure of PEFR while the subjects stays away from work for a few days and returns to work; a sudden dip in PEFR which remains low during the days of occupational exposure argue strongly in favor of OA.

Lung function tests are also used during bronchial provocation (both non-specific and specific) and are the gold standard in the diagnosis of OA. One has to be aware of false negative results due to concomitant optimal therapy of asthma.

Skin Tests and Serology

If an immunologic basis is suspected, suitable antigens have to be prepared from the suspected allergenic substances and used for prick tests. This requires collaboration with a basic scientist and his laboratory. After prick tests conducted among the subjects with suspected OA as well as controls in the same work environment, one can proceed to study the specific IgE levels against the suspected antigens. Demonstration of elevated levels of specific IgE antibodies in a subject, however, does not always correlate with clinical illness. These factors have to be correlated and viewed in the clinical context.

Bronchial Provocation Tests (BPT)

In order to be certain that one is dealing with OA, both non-specific BPT (with histamine and methacholine) and with a very dilute form of suspected allergen (specific) has to be performed. This is not always feasible in our context and conditions. It must also be borne in mind that while most cases of OA occur in subjects with past bronchial hyper-reactivity and history of atopy, there are instances where previously non-atopic subjects have also developed OA after a longer latent period.

Epidemiologic Evaluation

Apart from the evaluation of the individual workers with OA, it is essential to perform epidemiologic surveys to ascertain the prevalence of OA in a given industry. The most important aspect of such evaluation is the generation and use of comprehensive questionnaire. This will be of crucial importance. The second aspect is that of serial PEFR and other functional measures performed along the section of the workers (both symptomatic and asymptotic). These measures have to be both at work and while away from the workplace environment for specified periods of time. Such observations have to be made in an objective manner, with clinical symptom scores as well as PEFR measurements.

Management

The principles of management in cases of OA are clear but their execution is most difficult. To the extent possible, cessation of exposure to the offending substance in proven cases is the best measure. Here, it is important to realize that the sooner such cessation occurs after the development of symptoms, the better are the chances clinical remission in asthma. Studies have shown that after a long period of repeated exposures, the bronchial hyper responsiveness remains for years after cessation of exposure. The worker may either leave and seek an entirely new occupation or may be given a job in the same industry away from the exposure to the allergenic insult. Obviously, these steps have social economic and medico-legal implications and problem solving needs close cooperation of the worker, the factory Medical Officer, the personnel manager as well as the clinician involved in the assessment of these cases.

As it is known that atopic subjects are more likely to get sensitized to known and potent substances capable of causing OA, screening of these subjects and counseling them before they seek a job is very important. Such pre-employment screening as a preventive step is essential.

History, skin prick test with a battery of common prevalent allergens and PFTs will allow detection of substantially atopic subjects. But such facilities are not widely available at this time in our country.

Medical management of OA is similar to management of any asthmatic. Use of inhaled bronchodilators, inhaled chromolyn and inhaled steroids as well as judicious use of short courses of systemic steroids help in reduction of morbidity. But subjects on such long-term treatment need to be watched periodically for deterioration in lung functions as well as evidence of progression of poorly reversible airflow limitation.

Though it has long been recognized that occupational asthma is a disorder with medico-legal implications in terms of compensation, this aspect has not received sufficient attention in our country. In some of the Western countries some of the documented OA cases are compensable by appropriate legislation.

Occupational Health Aspects In Sericulture

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Sericulture industry in India is an agriculture based cottage activity being practiced since last 200 years by millions of rural families. Because of its high employment potential; good retums; low initial investments and simple techniques involved, more than 5 million people living in 50,000 villages are deriving their livelihood in different activities of sericulture. India, the second largest silk producer in the world accounting for 12% of raw silk production (13,000 M.T.) is also a major silk consumer. Silk has become the part of Indian culture and the silk occupies a prestigious and unique place in every household of the country. More than 90% of the raw silk produced in the country is consumed domestically and majority of it is used in production of sarees. In the country major silk producing states are Kamataka, West Bengal, Andhra Pradesh, Tamil Nadu and Jammu and Kashmir. The details of sericulture industry are given in Table -1. Of these, Kamataka is the leading producer and accounts for more than 60% of the country's production and Bangalore is called as the Silk City of the country.

Silk yam and fabric production is a synthesized activity comprising of 4 major activities namely i) Mulberry (Food plant) cultivation to produce leaf which is the sole feed for silk worm (Bambyx Mori) ii) Silk worm rearing to produce cocoons iii) Silk reeling to produce raw silk yam and iv) Silk weaving and finishing (Figure - 1). Of the four activities first two are paracticed by rural agrarian families and the latter two are mostly confined to specific localized centers and practiced by landless and large by non-farming families.

Since sericulture is a cottage activity involving traditional methods, it too has some occupational health problems similar to many other occupations. In addition to several advantages of the industry, the important health problems being faced by population involved in different activities of the industry are discussed briefly along with their probable solutions.

Breathing Disorders

It has been known for a long time that persons engaged in the process of silk work egg production (Grainage activities) are at risk to develop bronchial asthma believed to be allergic in nature (Harindranath et al, 1985). Asthma is triggered by fine scales in the air released by the fluttering of the silk moth. Male silk worm moths contribute more for release of scales from their bodies as they flutter more frequently during mating. People working in pairing, depairing etc. are prone to the inhalation of scales and develop allergy. This can be prevented by wearing masks consisiting of three layers of muslin cloth. The presence of exhaust fans in the pairing/oviposition rooms would reduce the concentration of scales in the given environment. Another area of hazardous activity is inhalation of acid fumes during acid treatment of bivoltine eggs and dyeing of silk fabrics using acid-baths in dyeing units. This also causes respiratory disorders for persons working in egg treatment and dyeing units. Therefore, care should be taken to avoid inhalation of acid fumes by providing exhaust fans for grainages and dyeing units and also proper ventilation should be provided to facilitate quick dispersal of acid fumes from the room.

In sericulture, formalin and bleaching powder are extensively used as general disinfectants to destroy germs in rearing houses and appliances. Use of formalin without certain precautionary measures causes burning of eyes, mucous secretions and peeling out of skin. Bleaching powder solution at higher concentration (>5%) causes similar hazards as hazards of formalin. Therefore, use of face masks, hand gloves and gum shoes are suggested during disinfecting the rearing room and appliances. The application of dust formulation like sanjeevini, suraksha or RKO powder and Uzi powder cause respiratory disorders and burning of eyes. Hence, protective cover for nose and mouth while working is advised.

During silk reeling, asthma is caused by the smoke emitted from cocoon cooking basins with fire wood and the stench from steam and vapour arising from fluids released from the pupal body. A few reports regarding the incidence of occupational asthma in sericulture are available from China and Japan. In India, a clinical survey in 1985 involving 2 silk filatures reveled that 36% of the total workers were suffering from bronchial asthma. It also showed that for 16.9% of the workers it was only due to the air-borne antigens originating from silk worm cocoons and pupae and hence their suffering is of occupational origin.

1. Skin diseases

The workers who are engaged in silk reeling units are more prone to fungal and other skin infections like dermatophytosis (ring worm infection) due to constant immersion of hands and during in hot and turbid water. This water is often placed with certain chemicals to improve the colour or quality of silk. The floor of most of the silk rearing units are wet due to constant water usage without proper drainage. In such circumstances feet get infected due to continuous contact with damp floors due to improper and unhygienic drainage system in reeling units.

Unless the whole process of reeling is mechanized, not much can be done to avoid immersing the hands in hot water during reeling and cooking. An antifungal skin ointment to be rubbed on hands and feet for preventing skin diseases and using small forceps to lift or cast out cocoons during reeling could be encouraged which may however, affect reelability/productivity. As per the advice of silk reeling experts, wearing of gloves all day long is not safer as this would prevent the hands from aeration and would itself lead to fungal disease. Hence, good ventilation, proper drainage to ensure minimum dampness, use of slippers, regular use of ointments and proper/ quick disposal of waste cocoons would prevent these health problems to a greater extent.

The separation of palade layer / waste cocoons from pupae is an infamous procedure by standing ankle deep dirty and foul smelling water in which spent cocoons have been dumped. Further, separating palade layer from the dead pupae by squeezing the individual cocoons by hand is a degrading task.

2. Other Hazards

Mulberry is prone to be attacked by certain pathogens, insect and non insect pests. Several pesticides have been recommended for using in mulberry gardens to check the incidence of diseases and pests. The use of pesticides causes severe skin burns while preparation of spray solution and also during the course of application. Therefore precautionary measures like use of hand gloves; devices, leak proof sprayers; glass rod/stick for stirring the liquids; face masks etc. have been suggested to avoid direct contact with pesticides. The people involved in weaving units do have certain problems due to sound pollution. The over-pick and under-pick power looms have more beat up sound which sometimes exceeds 150 decibels. This may induce gradual deafness to people involved in weaving units. However, this problem is not noticed in versatile machines with jet/rapier looms which produce lesser sounds. Use of cotton ball as ear plugs to avoid more sound is advised. People involved in fabric dyeing industries too are prone to certain health problems as they directly deal with dyes which are basically chemicals and some of them are harmful to skin. some of the dyes have been also banned for usage due to some health problems as they are reported to be carcinogenic. Hence, use of vegetable and eco friendly dyes has been recommended.

Silk consumer may not be aware of different biological and technological aspects through which the final beautiful fabric which adores the human beauty is prepared. Many hands toil to achieve the final product who live anonymous and deprived of the consumer appreciation, yet are satisfied for the work they do.

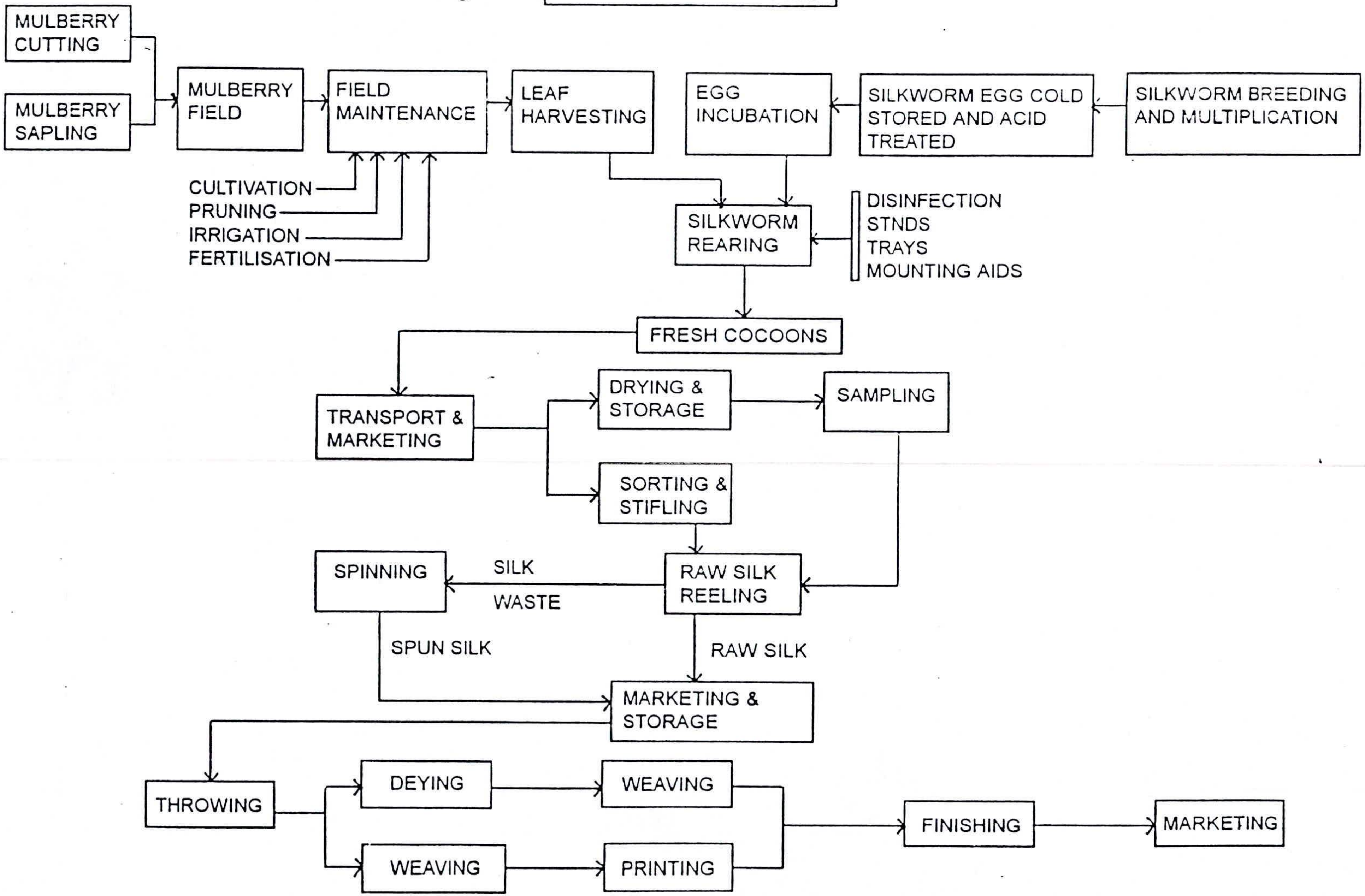
However, the recent government policies both at state and central levels must bestow their attention to organize special units in concerned hospitals; arrange health camps; periodical check up etc. to the workers engaged in the industry so that the suffering of these could be minimized if not fully solved.

STATEWISE MULBERRY SERICULTURAL STATISTICS FOR 1997-98

STATE	Area under mulberry (He)	Dfls. Lakhs	PRODUCTION OF Reeling Cocoons Tons	Raw silk Tons	Silk waste Tons	Filature & Cottage basins Nos.	Charaka Nos.	Hand Looms Nos.	Power Looms Nos.	No. of Seri-Culture Villages Nos.	Sericulture Families Nos.
Andhra Pradesh	38084	627.41	24809	2696	725	1193	1646	10000	-	9377	123458
Assam	2813	4.64	150	14.65	5	91	219	5000	-	7103	175631
Arunachal Pradesh	97	0.54	16	1.38	-	1	16	-	-	194	2600
Bihar	474	6.08	113	8.50	2	3	55	16000	-	4770	165000
Gujarat	63	0.10	2	0.12	-	12	-	-	-	127	900
Himachal Pradesh	356	4.68	114	14.40	4	30	-	-	-	1687	6666
Haryana	20	0.06	1	neg.	-	-	-	-	-	-	-
Jmmu & Kashmir	4717	31.62	785	84	30	392	-	1500	290	2626	NA
Karnataka	166000	1886.33	80656	9236	2495	19774	25089	22800	23300	16590	294777
Kerala	1164	0.78	31	3	1	-	-	-	-	NA	-
Madhya Pradesh	2043	11.3	143	14.35	5	40	97	4000	-	1314	15378
Maharashtra	706	5.53	161	16.12	9	21	10	225	-	1357	3284
Manipur	25975	13.92	497	49.10	14	75	500	-	-	354	2900
Mizoram	550	3.08	17	1.67	-	-	-	-	-	60	200
Meghalaya	135	1.00	14	1.38	neg.	11	-	-	-	1812	NA
Nagaland	612	0.18	6	0.60	-	15	-	-	-	140	7270
Orissa	487	2.78	56	5.60	4	17	-	5000	-	2300	39805
Punjab	620	0.94	30	3	1	2	-	-	-	819	1088
Rajasthan	134	0.46	10	0.33	-	24	-	-	-	114	1060
Sikkim	24	-	-	-	-	-	-	-	-	6	20
Tamil Nadu	9491	139.67	5705	601	232	3379	590	40000	-	4985	68871
Tripura	656	0.71	25	2.46	1	32	-	-	-	278	1740
Uttar Pradesh	5665	13.19	324	40.5	8	115	-	60000	5000	2017	20597
West Bengal	21358	600.23	13800	1254	464	1200	6000	12800	-	1580	80194
TOTAL	**282244**	**3355.23**	**127495**	**14048.16**	**4000**	**26427**	**34224**	**182325**	**29590**	**59528**	**1031439**

Figures represent 1996-97

Fig-1 SILK PRODUCTION CYCLE



Silicosis And Silico-Tuberculosis

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Silicosis is an occupational lung disease attributable to the inhalation of silicon dioxide, commonly known as silica, in crystalline forms, usually as quartz, but also as other important crystalline forms of silica, for example, cristobalite and tridymite. It is the most ancient and commonest of all occupational diseases and claims larger number of lives than any other occupational disease. Even today, it continues to be among the most serious occupational diseases. The crystalline free silica, the agent responsible for the causation of silicosis, is one of the most powerful fibrogenic matter found in Nature. It forms about 12% of the earth's crust and is next only to feldspar in abundance. Mining and tunneling are therefore occupations most closely related to the hazards of silica exposure. The sand stone industry, cement industry, quarrying,

Generation of a large cloud of dust during the cutting of slate pencil at Mandsaur (M.P.)

the granite industry, slate quarrying and dressing, grinding of metals, iron and steel foundries, silica milling, flint crushing and the manufacture of abrasive soaps and glass also involves occupations which may lead to silicosis. Some of the lesser known occupations which are important from hazard point of view and peculiar to India and some other developing nations are slate pencil cutting, agate polishing etc. In India there are about 1.7 million workers engaged in mining of various minerals, iron and steel industries, cement industry, manufacturing of glass, foundries, quarries etc. All these industries involve potential risk of exposure to siliceous dust and subsequent development of silicosis.

Amongst all the atmospheric contaminants encountered in industry, free silica has the dubious distinction of being the only dust which predisposes significantly to the development of tuberculosis. The occurrence of silicosis and tuberculosis together is known as 'silico - tuberculosis'. Susceptibility of silicotic patients to tuberculous infection has been established since the beginning of this century. The potentiating effect of free silica on tuberculosis was experimentally proved by Gardener in 1929[1]. He also produced an experimental evidence that in the presence of quartz, even normal nonpathogenic strains of mycobacteria, could produce tuberculosis. Later experimental studies and field investigations have confirmed that the atypical mycobacteria like myco. Avium and myco. Kansasii, are frequently responsible for tuberculous infection in silicotic patients. These atypical mycobacteria are poorly sensitive to most of the anti-tubercular drugs and therefore, the prognosis in these cases is poor.

The prevalence of tuberculosis has direct relationship with the concentration of free silica dust in the work environment. The incidence of tuberculosis increases with the severity of silicosis. High prevalence of tuberculosis has been reported from the industries involving potential risk of silica exposure.

Magnitude of the problem: Precise data on industry wise incidence of silicosis and tuberculosis are not available. However, there are strong reasons, from some of the survey works, to believe that the incidence of these diseases is very high in many industries. The problem of these diseases is more severe in small scale and cottage industries because of certain characteristic features of these industries. Most of these units are run by small entrepreneurs with limited financial resources and inadequate technical know how. The labour forces are unorganized and lack the ability of collective representation against exploitation like long hours of work, low wages, unchecked work place hazards etc. Medical facilities are usually non-existent. Due to high labour turnover and absence of periodical medical examinations, cases of chronic diseases like silicosis and tuberculosis usually pass unnoticed. To make the situation worse, most of these units are beyond the purview of legal provisions like Factories Act and ESI Act which are aimed at safeguarding health, safety and welfare of the industrial workers.

In Table 1 the findings of the author as regards to the prevalence of silicosis and tuberculosis in some of the small scale and cottage industries have been summarized. The industrial hygiene study in the industries mentioned in the above table showed the dust levels several times higher than the prescribed threshold limit value (TLV). It is seen from the above table that the prevalences of silicosis and tuberculosis were very high. The prevalence of tuberculosis varied from 15% to 34.8%. In the slate pencil industry, despite very high prevalence of silicosis, the prevalence of tuberculosis was lower than that in other industries. In this industry, highest levels of silica dust were found and the follow up examination of workers showed rapid progression of the disease resulting in high mortality in relatively short duration[2,3] and Chatterjee 1985). It is quite likely that many workers suffering from silicosis might have succumbed to the disease before developing tubercular infection. On the other hand, it is also likely that many cases of tuberculosis might have been masked by silicosis.

Table 1 : Prevalence of silicosis and tuberculosis in some small scale. and cottage industries.

Industry	Silicosis No (%)	Tuberculosis No (%)
Slate Pencil Cutting (n=593)	324 (54.7)	89 (15.0)
Ceramic Industry (n=292)	44 (15.1)	44 (15.1)
Agate Grinding & Polishing (n=468)	136 (29.1)	131(30.1)
Stone Cutting (n=89)	17(19.1)	31(34.8)

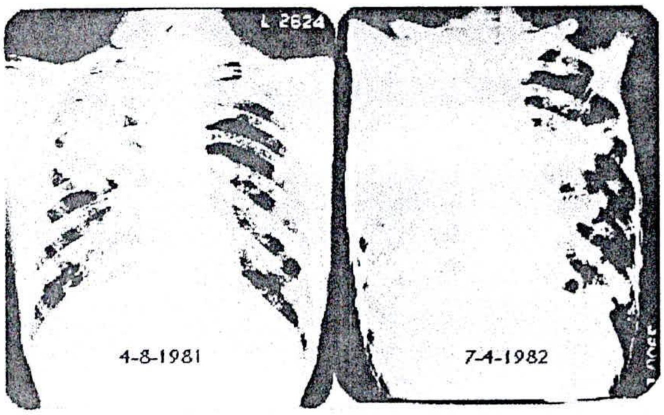
The diagnosis of tuberculosis in silicotic patients is relatively difficult because the silicotic lesions may be indistinguishable from the tuberculosis on radiographic examination.

The data on relationship between severity of silicosis and occurrence of tuberculosis in slate pencil cutting industry and ceramic industry have been pooled and presented in table 2. It is evident from the table that the prevalence of tuberculosis increase with increase in the severity of silicosis.

Table 2: Prevalence of tuberculosis according to severity of silicosis.

Severity of Silicosis	Number of cases	Tuberculosis
Category 0	517	44 (8.51)
Category 1	161	24 (14.91)
Category 2	145	35 (24.14)
Category 3	62	25 (40.32)

Clinical Features: It is important to emphasize that there may be no symptoms even though the radiographic appearances may suggest fairly advanced silicosis. Dyspnoea on exertion is considered to be the most frequent and directly related symptom of silicosis. The severity dyspnoea increases with progress of the disease. In the absence of complicating disease (e.g. tuberculosis), it is rarely complained off at rest. Slight unproductive cough is complained at the initial stages, later on the quantity of sputum increases. The symptom complex may resemble chronic bronchitis. Excessive sputum production is due to bronchial catarrh brought about by



PMF: Male, 22 years, worked as a slate pencil cutter for 9 years. Second X ray was taken after 8 months. Died shortly after the second x ray.

chronic dust exposure and some times it is due to secondary bacterial infection of the devitalized lungs. Chest pain and haemoptysis (blood in sputum) indicate possibility of complication like tuberculosis.

Chest Radiography: Chest radiography is the most important tool for the diagnosis of silicosis. There appears clear relationship between total dust exposure and severity of radiographic changes. In the initial stage, there is 'reticulation' of lung fields due to thickening of perivascular and inter-communicating lymphatics. The radiographic diagnosis of silicosis can be made with some degree of certainty only after the appearance of nodules. The silicotic nodules are 2-5 mm in diameter, homogenous density and usually bilaterally symmetrical. On continuation of dust exposure, the nodules increase in size and number and eventually cover most parts of the lungs. Sometimes the silicotic nodules unite and form 'conglomerate shadows'. These conglomerate shadows are sometimes described as progressive massive fibrosis (PMF), indicating the future course of disease (See above figure).

Sputum examination for Tubercle Bacilli: Surest method of establishing diagnosis of pulmonary tuberculosis is the demonstration of bacilli in sputum. However, the recovery of tubercle bacilli in the sputum of patients suffering from silico-tuberculosis is difficult. This is because of "walling in" of tubercle foci by silicotic fibrosis which prevents the discharge of tubercle bacilli in the sputum. Large number of cases of tuberculosis remain undiagnosed during life is evidenced from the fact that very high prevalence of tuberculosis is usually observed in post mortem study of industrial population occupationally exposed to high levels of silica. Gardner[4] found evidence of tuberculosis between 65% and 75% silicotics from various industries. Yuang Ching Co[5], Barras[6] and Schyczmykiewicz et al[7] found post-mortem evidence of tuberculosis in 48%, 50% and 52% in silicotics respectively. James[8] and Rivers et al[9] found evidence of tuberculosis in 40% and 35% cases of progressive massive fibrosis (PMF) respectively at autopsy examination. However, during life, the recovery rate of tubercle bacilli from sputum of the South Wales miners with PMF was very low, i.e. 1.1%(Cochrane et al[10]) and 2.7% (Marks[11]).

Differential diagnosis between silicosis and tuberculosis: For the diagnosis of silicosis, satisfactory occupational history of silica exposure is most important. Occurrence of silicosis in the absence of occupational exposure is rare[12]. Radiologically, silicosis and miliary tuberculosis closely resemble each other, however, miliary tuberculosis in adults is rare and the patient is toxaemic. The nodules in miliary tuberculosis whether small or large, are less than those of silicosis. The radiographs of silicosis usually show increased translucency as against general loss of translucency in tuberculosis. In general, the severity of symptoms in a patient suffering from simple nodular silicosis is much less as compared to the one suffering from miliary tuberculosis. The distinction between adult type (post-primary) tuberculosis and conglomerate (PMF) radiological shadows is some times very difficult. However, the conglomerate shadows of silicosis do not show cavitation. Associated complications like pleural effusion and distortion of the intra-thoracic organs due to fibrosis are usually not observed in conglomerate shadows.

The above description is that of classical silicosis. However, in some cases, silicosis may develop within a few months to 2 years of massive silica exposure. Dramatic dyspnoea, weakness, and weight loss are often presenting symptoms. The radiographic findings of diffuse alveolar filling differ from those in the more chronic forms of silicosis. Histologic findings similar to pulmonary alveolar proteinosis have been described, and extrapulmonary (renal and hepatic) abnormalities are occasionally reported. Rapid progression to severe hypoxaemic ventilatory failure is the usual course.

Therapy, Management of Complications and Control of Silicosis[13] There is no specific treatment of silicosis, the therapy is directed largely at complications of the disease. Historically, the inhalation of aerosolized aluminium has been unsuccessful as a specific therapy for silicosis. Polyvinyl pyridine-N-oxide, a polymer that has protected experiment animals, is not available for use in humans. Recent laboratory work , particularly in China, with tetrandrine has shown in vivo reduction in fibrosis and collagen synthesis in silica exposed animals treated with this drug. However, strong evidence of human efficacy is currently lacking, and there are concerns about the potential toxicity, including the mutagenicity, of this drug. Because of the high prevalence of disease in some countries like China, India and many other developing nations, investigations of combinations of drugs and other interventions continue. Currently, no successful approach has emerged, and the search for a specific therapy for silicosis to date has been unrewarding.

Further exposure is undesirable, and advice on leaving or changing the current job should be given with information about past and present exposure conditions. In the medical management of silicosis, vigilance for complicating infection, especially tuberculosis, is critical. The use of BCG in the tuberculin-negative silicotic patient is not recommended, but the use of preventive isoniazid (INH) therapy in the tuberculin-positive silicotic subject is advised in countries where the prevalence of tuberculosis is low. The diagnosis of active tuberculosis infection in patients with silicosis can be difficult. Clinical symptoms of weight loss, fever, sweats and malaise should prompt radiographic evaluation and sputum acid-fast bacilli strains and cultures. Radiographic changes, including enlargement or cavitation in conglomerate lesions or nodular opacities, are of particular concern. Bacteriological studies on expectorated sputum may not always be reliable in silicotuberculosis. Fiberoptic bronchoscopy for additional specimens for culture and study may often be helpful in establishing a diagnosis of active disease. The use of multidrug therapy for suspected active disease in silicotics is justified at a lower level of suspicion than in the non-silicotic subject, due to the difficulty in firmly establishing evidence for active infection. Rifampin therapy appears to have enhanced the success rate of treatment of silicosis complicated by tuberculosis, and in some recent studies response to short-term therapy was comparable in cases of silicotuberculosis to that in matched cases of primary tuberculosis. Ventilatory support for respiratory failure is indicated when precipitated by a treatable complication. Pneumothorax, spontaneous and ventilator-related, is usually treated by chest tube insertion. Bronchopleural fistula may develop, and surgical consultation and management should be considered.

Prevention and Control of Silicosis and Silico-tuberculosis:

There is need for planning National strategy for the prevention and control of silicosis and silico-tuberculosis. Country wide silico-tuberculosis control should consist of two major components: 1. Definition of magnitude of the problem at national level. and 2. Implementation of actual control measures.

Definition of Magnitude of the Problem at National level:

To plan and execute the national strategy for the prevention of silico-tuberculosis the knowledge of total population at risk and number of people already affected is very essential. The population at risk of silicosis can be roughly estimated on the basis of available information on industries, their location, raw material and industrial process and employment in each of them. This should be followed by comprehensive industrial hygiene and epidemiological surveys in sample population. After estimation of population at risk and identification of more vulnerable groups, the industrial and medical surveys should be carried out. The industrial hygiene survey shall include measurement of "total" and "respirable" dust at work places and the qualitative analysis of dust samples. The tools of epidemiological survey are recording of occupational history, clinical history and physical examination, chest radiograph, sputum examination and spirometry. Chest radiography is the most important single investigation having a high degree of specificity but relatively low sensitivity. The history and physical examinations help in excluding other respiratory diseases. The spirometry may help in appraisal of the functional loss. The results of the sample surveys will help in identifying the thrust areas. The thrust areas may be defined on the basis of number of people at risk and the severity of hazard. Industries having moderate risk but employing a large work population e.g. the mines, or highly hazardous industries employing smaller number of workers e.g. slate pencil industry, agate industry, quartz grinding industry etc., fall in this category. For the reasons already mentioned, there is a special need for looking into the problems of small scale and cottage industries.

Implementation of Actual Control Measures:

The process of the control of silicosis consists of, (1) Dust control measures and (2) Medical measures.

Dust control measures:

There is no silicosis without dust exposure, and the dust levels in work environment correlates well with incidence of severity of the disease. Therefore, elimination or suppression of dust in the work environment is the key in control of silicosis. Each industry has its unique work process and therefore it is not possible to have a single prescription appropriate to all. The general principles of dust control measures include substitution of more hazardous substances with innocuous one, isolation and enclosure of the sources of dust, use of wet methods wherever possible, application of local and general exhaust, humidification of work environment etc. Frequently, the management is found to share the misconception of laymen that the supply of dust mask is sufficient for the prevention of dust related occupational diseases in the industry. The personal protective equipments such as masks should be prescribed only when all available methods of dust control measures have failed. In fact, the dust masks are of little value when the dust concentrations are too high for the dust particles will soon clog the pores in the filter resulting in a choking sensation and discontinuance of the use of masks by workers. Moreover, the masks are not suited for hot and humid climate.

Medical Surveillance:

As per the recommendation of WHO[14], the medical screening programme should be integrated and pursued with the *environmental surveillance programmes* so that the results of both could be related to reviews of measures taken to control the environment. The medical examination is necessary because perfect knowledge does not exist as to the safe level of exposure. Medical surveillance should be continued, not as control method, but to verify the adequacy of dust control measures. The medical measures for the control of silicosis and silico-tuberculosis include pre-employment and periodical examinations, incorporating chest x-ray, sputum examination for tubercle bacilli and spirometry. The pre-employment medical examination will provide the baseline data for each individual. The periodical medical examinations shall aim at early detection of cases of silicosis and tuberculosis. The success of the prevention programme will largely depend upon the active co-operation of the workers at risk. Therefore, the need for health education of the workers can not be over emphasized.

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Toxic Lung Injury

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INTRODUCTION

The respiratory tract represents a unique, vast battleground. With its high surface area and rich vasculature and is in delicately balanced state of siege. The upper respiratory tract is an important point of entry of toxins which may effect not only the lungs but other organs as well. The outcomes of the assaults range from minor irritation to respiratory insufficiency to life threatening systemic toxicities.

Inhalation is probably a most important route of exposure in the work place. The list of potential toxins is legion including air pollutants, pesticides, cigarette smoke, food grain dust, etc. Some exposures produce lung injury with a single inhalation. Others may act insidiously taking effect only after many years of exposure. However, as the toxic injury progresses the pathologic and clinical sequel can be expected to form into one or more stereotypic patterns :

1. Irritant reversible effects on the lower / or upper respiratory tract.
2. Permanent damage to the airways.
3. Damage to the gas exchange units of the lungs.
4. Oncogenesis.

Some agents produce multiple effects for e.g. Asbestos can cause not only pulmonary fibrosis but lung cancer as well. Cigarette smoke effects range from chronic bronchitis to emphysema and lung cancer. Hydrogen Sulfide can produce everything from upper airway irritation to pulmonary edema and respiratory paralysis.

Pulmonary Toxins And Respiratory Tract Anatomy

Deposition and retention of air borne substances are dictated partly by the anatomy of the respiratory tract. The arbitrary subdivisions as nasopharyngeal, tracheobronchial and pulmonary is to simple and most of the toxic agents tend to effect in varying degrees the three subdivisions. The respiratory tract is more than a series of interconnected tubes having more than 40 types of specialized cells, which vary in their susceptibility to inhalation injury.

Epidemiological studies have suggested respiratory pathophysiology associated with occupational exposure to grain dust. Workers from farm to grain storage terminals experience dust exposures and possible lung disease from handling grain. Grain storage workers are exposed to airborne dusts of heterogeneous composition. Respirable dust levels are reported to be responsible for observed adverse health effects.

DEPOSITION AND CLEARANCE OF INHALED SUBSTANCES

Gases and Aerosols basically are two main forms of pulmonary toxicants. Aerosols are droplets of liquid or particles suspended in air or gas. The sight of deposition of inhaled toxicant is largely determined by the solubility of the toxicants in the aqueous layer of the respiratory mucosa. The toxicants that are extremely water soluble such as Ammonia and Sulfur Dioxide will be deposited and removed predominantly by the upper respiratory tract. The less soluble the toxicant the greater the potential for damage at the level of the terminal respiratory unit.

The size of the toxicant particle is usually the predominant factor effecting deposition although the particle density and shape contribute to the pattern. The majority of the particles greater than approximately 10 microns in diameter or successfully filtered out by the nasopharynx. Particles in the range of 0.5 to 3 microns are deposited predominantly in distal airways and alveoli. Particles less than 0.5 microns in diameter are mainly exhaled without significant deposition. Lung cells vary in their susceptibility to toxic agents and are major determinants how inhaled toxicants effect the respiratory tract. Similarly, particle clearance is of equal importance in determining the toxic effects of inhaled agents.

TOOLS IN ASSESSMENT OF PULMONARY TOXICITY

1. Occupational Exposure Assessment :

- History
- Materials safety data sheets
- Insight investigations
- Detection of minerals in the lung
    - Light microscopy
    - Electron microscopy

2. Clinical examination

3. Chest Imaging

3.1 Chest Radiography:

The chest radiograph is one of the cornerstones in the assessment of toxic injuries to the respiratory tract. Although evidence of obstructive lung disease can be found on chest radiograph, the greater application pertains to toxic injuries, which produce interstitial infiltrates, such as pneumoconiosis. Classically to look at are (a) shape of opacities (e.g. irregular versus rounded); (b) size of opacities; (c) profusion (the number of opacities per unit lung); (d) the extent and location of the infiltrates (e.g. upper lobe versus lower love predominance); and (e) presence of ancillary findings such as pleural plaques, adenopathy, pulmonary hypertension, cardiac enlargement, and Kerley's lines. These five main observations from the basis of a formal reading system known as the International Labour Organization (ILO) 1980 Classification of Radiographs of the Pneumoconiosis. Although designed for the systematic recording of radiographic changes caused by inhalation of mineral dusts, the principles can be applied in reading films from any of the diffuse interstitial diseases.

By this classification, small opacities (less than 10 millimeters in diameter) are described as "rounded" as seen in diseases such as silicosis, or "irregular" as seen in asbestosis. The letters "p", "q" and "r" are used to subdivide rounded opacities according to size – upto 1.5, 1.5-3.0, and 3.0-10.0 millimeters, respectively. Similarly, the letters "s", "t" and "u" describe the predominant sizes of small irregular opacities. In the classification system each radiograph's opacities are classified according to the most common and next most common shape and size. For example, "s/t" indicates that the majority of opacities are size's, and the second most common size is t. profusion. The number of small rounded or small irregular opacities per lung zone, is divided into four main categories from 0 through 3 and these are further divided along a 12-point scale ranging from 0/- to 3/+. To score the extent of involvement, each lung is arbitrarily divided into three zones by horizontal imaginary lines one third and two thirds of the distance between the apex of the lung and the dome of the diaphragm.

The ILO classification also systematically describes large opacities (greater than 10 millimeters) as well as pleural plaques and other abnormalities. A set of standard ILO reference films are routinely used by readers in judging the shape, size and profusion of opacities of a given chest radiograph.

The opacity's shape (round versus irregular) is of limited utility. Most interstitial lung diseases can present with a range of opacities from pure round to reticular nodular to pure linear or irregular. Even in simple silicosis-the classic example of rounded opacities – the opacities can assume a more reticular appearance on the chest radiograph, depending on factors such as dust burden and duration of illness.

Distribution of diffuse infiltrates may be of slightly greater predictive value, although again there are many exceptions. Opacities are found throughout the lungs in most interstitial lung diseases. However, in a number of toxicants-induced diseases there is lower lung predominance. Examples include nitrofurantoin-induced disease, metallic mercury embolism, interstitial pulmonary edema, pulmonary fibrosis, asbestosis, and talcosis . Relatively few of the diffuse interstitial lung diseases will show upper lung field predominance, with two notable exceptions from the standpoint of toxic inhalation: silicosis and chronic beryllium disease. Hilar adenopathy, with or without "egg shell" calcifications, is seen in silicosis as well as in some cases of coalworker's pneumoconiosis and occasionally in chronic beryllium disease.

A pattern of acute pulmonary edema in a patient without trauma or heart disease raises the specter of chemical exposure. The typical pattern will be that of diffuse fluffy alveolar infiltrates but with a normal heart size. Drugs that can cause a non-cardiogenic pulmonary edema pattern include amphotericin B, aspirin, hydrochlorothiazide, lidocaine, major tranquilizers, opiates, and sedatives as well as sympathomimetic agents. Alveolar hemorrhage is often indistinguishable from the pulmonary edema pattern on chest radiograph. This can result from a number of exposures including agents such as D-penicillamine and trimellitic anhydride.

The limitations of the chest radiograph need to be acknowledged. First, chest radiograph often correlates poorly with the clinical activity of interstitial lung diseases. For e.g. the chest radiograph may be markedly abnormal in coal workers who have normal pulmonary function. A number of inhaled dusts may produce "benign pneumoconiosis". When dusts are radiodense, they produce radiographic changes but with little or no pathologic or physiologic abnormality upon further investigation. Conversely, some patients with significant pulmonary embarrassment have normal appearing chest radiographs. Radiographically inapparent clinical illness can occur in patients with farmers lung or other hypersensitivity pneumonitides, beryllium disease, and asbestosis.

A second major limitation of the chest radiograph is its lack of specificity. Many types of injury produce similar radiographic changes. This lack of specificity prevents us from relying too heavily on the chest radiograph in differential diagnosis of chest disease. For e.g. although it is classically taught that silicosis produces small rounded opacities predominantly in the upper and mid-lung fields, there are many cases described in which the disease may have lower lobe predominance with a more reticular appearance on chest radiograph. Asbestosis is classically credited with producing small irregular opacities in the lower lung fields; however, this disease can produce mid- and upper lung field predominant disease. Even the presence of pleural plaques, which may occupational medicine physicians equate with asbestos exposure, has limited specificity. There are many pulmonary diseases (related or unrelated to toxicological insult) which can produce bilateral pleural disease, including silicosis, diatomaceous earth pneumoconiosis, and chronic beryllium disease. Previous chest surgery or chest trauma may also confound the assessment of pleural disease. However, in the proper clinical context, presence of plaques and infiltrates in an asbestos-exposed individual may be sufficient to diagnose asbestosis.

3.2 Gallium Scintigraphy

3.3 Computerised Tomography

4 Physiological assessment

4.1 Spirometry

4.2 Lung Volume Assessment

4.3 Gas Exchange

5 Endoscopy

6 Immunologic evaluation of pulmonary toxicity

The list of agents that can cause lung injury is legion and range from minor irritant to carcinogens.

Clinical approach to the evaluation of suspected reactive airway disease (Asthma), intestinal lung disease and common causes of occupational and environmental lung cancer will be outlined in the presentation.

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Tuberculosis Among Agricultural Workers And Its Control

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TUBERCULOSIS is the world's foremost cause of death from a single infectious agent[1] and annually there are about 3 million deaths from tuberculosis (TB) all over the world[2] with about 15% of these occurring in India alone[3]. The brunt of the disease is borne by those in the age group[4] of 15-59 years. Approximately 6.7% of all deaths[5] and 18.5% of deaths in the above age group[6] in the developing world are attributable to TB. An estimated one-third of the world population is infected by M.Tuberculosis, with 95% of TB cases occurring in developing countries. Among more than 900 million people in India today, every second adult is infected with the tuberculous mycobacteria and each year more than 2 million people develop active TB. At any point of time in the country, there are 14-15 million TB patients,[6] which is nearly one third of the global burden of this disease. About 3 million of these cases are highly infectious and spread the disease in the community [6].

TB is largely a disease of adults. Within adults, it is prevalent more in older adults than younger adults and more among males than females[7]. Although morbidity and mortality in any age group have significant economic and social consequences, no community can afford to loose its citizens in prime years of life since these are not only the productive years in terms of wage earning but also a period of shouldering family and social responsibilities.

Before 1950, it was widely believed that the problem of TB was only localised to big cities. The first disease survey carried out by Dr Frimodt Moller in the villages of Madanapalle district revealed that TB was prevalent in rural areas also[8]. The strategic importance of TB control in rural areas of the country was recognised when the *National Sample Survey indicated that 70-80% of TB cases resided in rural areas* since TB was as prevalent in rural areas as in urban areas[7]. Most of the later surveys carried out in different parts of India have been conducted in the rural areas. These surveys reveal that TB continues to be as highly prevalent in these areas as ever before[7-16] (Table 1) and that only a small

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proportion of rural population escapes infection through good luck or innate resistance.

Annually, more than *three lakh TB deaths take place in rural areas out of the total 4.5-lakh TB deaths in the country*[17]. About 5 to 6% of all deaths in rural

India are contributed by TB[17]. The age and sex distribution of deaths due to TB in rural India is given in table-2[17].

Though *TB deaths are more common amongst males*, it is pertinent to mention that *TB kills more women than all other infectious diseases and maternal deaths combined*[18]. An analysis of the TB problem among rural women requires understanding it in an socio-economic context. The rural women are often ignored in terms of preference and priorities in getting medical facilities. It is only when the situation worsens and they are unable to take up household activities that they are brought for the treatment. Women are also disadvantaged in terms of nutritional status, multiple responsibilities and specific household tasks such as cooking in the ill-ventilated enclosures. All these conditions make rural women more conducive to make them fall an easy victim of the disease.

More recently, rural populations have become more mobile and many migrate to urban areas where they have to live in sub-standard housing conditions, which is a further risk for developing tuberculosis. Increased rates of TB have often been observed in migrant population.

In the rural areas of the country, *TB is still considered to be a socially outcaste disease.* The patients suffering from the disease often do not disclose it for a long time. It has partly to do with their lack of knowledge of the symptoms of the disease and also due to the negative reactions that they fear from the people around them.

In a study conducted in Pune district, one out of every three TB cases were found to be engaged as agricultural labourers[19]. In another study conducted among farm workers of Uttar Pradesh, one out of every five workers suffered from some kind of respiratory disease and one-fifth of the respiratory diseases was due to pulmonary TB[20].

The agricultural occupation is associated with an increased risk of TB because it attracts workers in a high-risk category for TB since most of them have poor nutritional status and live in poor housing conditions. Farm workers are often migrant labourers, they are often not in full time employment and are thus in a low socio-economic stratum. They may also be predominantly male. These characteristics are all associated with increased risk of TB. Many a time, the agriculture and farm workers have to work under dusty conditions leading to high incidence of silicosis among them. Since the patients with silicosis are at a higher risk of developing TB[21], the agricultural workers specially those exposed to dust storms comprise a high-risk group for developing TB. Humans usually acquire TB infection from their immediate environment rather than from an animal source. However, there is a real risk that agricultural people living in closer contact with cattle may acquire the infection from them especially when systematic pasteurization or sterilization of the milk by boiling is not practiced.

In the survey carried out in the central Indian district of Wardha in Maharashtra, it was found that 42% of the rural population aged 5 years and above was engaged in agriculture[12]. *About 85% of the working population in rural areas and 20% in urban areas were engaged in agriculture[12] related activities. One out of every two chest symptomatics found in the survey was an agricultural worker* since a higher proportion of them (3.1%) had symptoms of cough with more than 2 weeks duration, chest pain, prolonged fever or history of haemoptysis compared to 1.9% of the overall population. Even though the prevalence of sputum positive pulmonary TB among the agricultural workers was not statistically different from that in the overall population or among other categories of workers, *about half (46%) of the total disease prevalence in the district was contributed by agricultural workers[12].*

On extrapolating the above data nationally, it can be surmised that about *four million agricultural workers suffer from TB at any given point of time, 1.0 million of them are infectious in nature* and spread the disease to their family members, neighbors and co-workers. The time off from work prior to diagnosis and during treatment is an economic loss to their families and many of the caregivers also have to take time off from work to assist them. Therefore, *the high prevalence of TB in India has serious and adverse consequences on the agriculture produce and thus on overall economy of the nation.* Also, the deaths of these workers in the prime of their age have a particularly onerous burden and its consequences on children and other dependants can be great. Being from lower socio-economic strata, they are also the people who are least able to cope up with the disease. Thus the effects of the disease on agricultural families can be devastating both financially and emotionally.

With the population growth, the absolute number of TB cases in the country has been on the increase. The advent of HIV epidemic has already facilitated the return of TB to wealthy nations[3]. In the developing countries where the disease was never controlled, the situation is expected to worsen in the future as a result of the increasing HIV seroprevalence rates since HIV infection is the single most important risk factor for developing TB[3].

A NATIONAL TUBERCULOSIS PROGRAMME (NTP) is being implemented in the country as an integral part of the general health services since 1962. The programme was evolved by the National Tuberculosis Institute (NTI), Bangalore after the valuable research studies carried out by it threw light on the epidemiological and operational aspects of the programme. Earlier, it had been established by Tuberculosis Chemotherapy Centre, Chennai that the efficacy of domicilliary treatment was as good as treating them at the sanatoria. It was decided that the programme should be felt-need based since a majority of the patients seek treatment at various health institutions. The *objectives of NTP are as under:*

1. To reduce deaths due to TB.
2. To detect as large a number of TB patients as possible and treat them effectively so that the infectious patients are rendered non-infectious and active and non-infectious cases do not become infectious.

To achieve the above objectives, following components were considered necessary:

1. Sputum diagnoses of all cases at the primary health care level.
2. Domiciliary treatment of the detected cases.
3. Provision of basic facilities and basic record keeping at the Peripheral Health Institutions (PHIs) which include Primary Health Centers (PHCs) and Community Health Centers (CHCs).
4. Improvised referral services and the access to specialized services for more complicated cases.
5. Having a District TB Centre (DTC) at each district, which would not only be responsible for implementing NTP in the district but also provide referral services to the PHCs and CHCs, which form a part of the health service delivery system in the rural areas.

The basic organisational unit of NTP is the District TB Programme (DTP). There are four activities under DTP namely:

(1) Case-finding
(2) Treatment
(3) Management
(4) Recording and reporting.

Case-finding activities in DTP are undertaken by examining the symptomatics attending the various Health Institutions.

Under the programme, *the treatment of sputum positive TB patients has been accorded priority* over that of sputum negative cases in order to cut the chain of transmission. Treatment is decentralized and is offered on a domiciliary basis. *Anti-TB drugs are issued free* and defaulter action is taken in respect of TB patients who default in the treatment.

Management of DTP covers planning, implementation and maintenance of various activities under DTP and the responsibility of this rests with the District TB Officer (DTO) assisted by his key staff.

The activities under the DTP are co-ordinated through a system of proper recording and reporting which facilitates rendering the service to the community.

CONSTRAINTS IN TB CONTROL

TB still tops the list of causes of deaths and disease in this country and the *problem in rural areas of the country has not declined* from the situation 50

years ago in spite of the advent of anti-TB drugs and implementation of the NTP. Even the *case fatality rates have remained high* as shown by the surveys conducted by NTI before implementing the programme and 20 years after implementation of the programme[22].

One of the most significant obstacles of achieving TB control is the challenge of implementing TB control activities in rural populations as the *health care infrastructure in most rural areas of the country is still poorly developed. Accessibility is affected* by the factors such as distance to the nearest place where the patient could go for treatment, which is usually far away in rural areas. It often takes one full day for the patient to make a single visit especially in view of general lack of transport facilities. Moreover, poor socio-economic conditions of the communities make it difficult for the people to travel to far off places at the cost of losing a day's wage.

Many of the rural TB patients do not present themselves to medical facilities in time with the result that there is a *delay in diagnosis*[23]. This delay may be because of financial barriers that include the cost of transportation and loss of wages besides the fact that *a significant proportion does not feel sick enough to seek care*[24]. Many of the cases are not even aware of the availability of treatment in public health services[19].

Many a time, *the patients on approaching a medical facility are returned undiagnosed* and some incur sizeable expenditure on general antibiotics before they are diagnosed as TB.

There has been an *overemphasis on using X-rays* for diagnosing TB, which leads to overestimation of cases. X-rays, as a case-finding tool has severe limitations and is about 7-10 times costlier than sputum microscopy, which is also a more reliable diagnostic tool[25].

Inability of the health providers to administer complete and regular treatment for 6-8 months is a major impediment to controlling TB. Irregular supply of drugs especially to PHCs, low image of public health services, lack of patient-doctor rapport and high cost of care which include travel cost, loss of wage and doctor's fees and cost of drugs when taking treatment from the private sector are some of the important reasons.

The rural PHIs lack the administrative and technical support from the DTC and implement the TB programme in a perfunctory manner. Often, there is shortage of basic supplies like sputum cups, slides, strain and drugs. Little attention is paid to patient's education and there is general lack of accountability for all categories of health persons.

Under the National Tuberculosis Programme, antitubercular drugs are provided free of cost to the patients. There is a *shortage in the government pharmacies and the* patients have to incur the high cost of procuring drugs at the market price. Thus, even in a programme offering free service, there are direct and indirect costs to the patients, which may encourage drug defaulting in the long run.

Almost half of the patients depend upon public health services for relief[24]. However, the services are not satisfactory in many parts of the country with the result that patients have to seek relief from private health agencies. In addition to high service charges, these *private agencies rely more on X-ray of the chest for diagnosis and may not adhere to the standard drug regimens*[26] leading to financial losses for the patient and increased possibility of drug resistance. A high proportion of the TB patients incurs debt being unable to bear the expenses of the treatment.

The key staff of the DTC seems rather satisfied being engrossed in providing clinical services and pays *little attention to management and supervision of the programme* in the district. Recording and reporting under the programme is equally bad to give any reliable information on either epidemiology of the disease or efficiency of the DTP.

In the presence of inefficient case-finding and poor treatment completion rates, the problem due to the disease continues to be unabated. *Less than 50% of the patients adhere to the complete course of treatment*[27]. When the treatment is not completed, not only is the patient's life jeopardized but also the patient continues to infect others in the community and such infections have a greater likelihood of becoming multi drug resistant. The cost of treating such patients is so enormous that it is beyond the scope of any health programme. One of the alternatives adopted to overcome the problem of drug default has been the gradual replacement of the 12 month long course treatment with a shorter and more effective six month *short course chemotherapy* (SCC), which leads to better compliance resulting in higher cure rates. Even though SCC has been proven to be more cost-effective than long course regimen so far it has been introduced only in 294 districts.

Since the group of agricultural workers is one from lower socio-economic strata, many a times these workers have to move from one place to another seeking livelihood. These characteristics pose particular problem for TB control programme.

APPROACHES FOR IMPROVEMENT OF TB CONTROL ACTIVITIES

Several innovative approaches would have to be developed to overcome these problems in implementation of NTP especially for achieving and sustaining high cure rates for all rural patients with infectious TB.

The importance of prescribing appropriate anti tubercular drug regimens and preventing treatment default cannot be over-emphasized. Effective TB treatment not only cures current cases but also prevents future cases, which are indirect benefits of chemotherapy. One of the major determinants for successfully treating TB is the level and intensity of supervision by the health care delivery system. The approach that has been adopted by TB programs all over the world is to ensure that each dose is administered to the patient under the supervision of a health worker or a dedicated health volunteer. This strategy is called the ***Directly Observed Treatment Short course (DOTS)*** and has yielded high cure rates[28] of 85-90% in many countries and in pilot areas of our country.

DOTS is the only way of ensuring high cure rates and thus has the benefits of reduction in transmission of infection by rendering infectious cases non-infectious. There are additional savings in future due to lower numbers of relapses and preventing development of resistance to antibiotics in both of which situations, treatment is much costlier.

THIS REVISED STRATEGY OF NTP takes advantage of the technology revolution, which took place by the introduction of DOTS. In countries like Tanzania, it was shown that DOTS had enhanced the rate of reduction in infectors (diseased) and infected (potential) by 50% in 15 years[29]. The revised strategy of NTP also effectively utilises the enhanced availability of infrastructure and manpower that has developed in the primary health care system over the years, but has not been utilised under the NTP.

The objectives of the revised strategy are as under:

1) To cure at least 85% of all newly detected cases of pulmonary TB with supervised SCC.
2) To detect at least 70% of the estimated incidence of smear positive pulmonary TB cases. However, efforts at increasing case detection would be made only after achieving 85% cure rate in the already detected cases.

A chest symptomatic reports to the nearest health facility, where his sputum is tested. In case sputum examination facility if not available here, then the patient is referred to the nearest Microscopy Centre. After three sputum samples have been examined, the patient is put on anti-TB treatment in case at least two of the three samples are positive. If only one sample is positive, an X-ray is taken. The medical officer decides the treatment to be given on the basis of X-ray and clinical examination. If all the three sputum specimens are negative, then the patient is given a course of antibiotics for 7-10 days. In case symptoms still persist, then X-ray is taken and the medical officer decides on the subsequent treatment.

Anti-TB treatment is administered depending upon category of the patient. During intensive phase, DOTS is administered with the help of a peripheral health functionary; while in continuation phase a patient collects the drugs on weekly or fortnightly basis. Drugs are taken 3 times / week throughout.

Drug administration is appropriately recorded on the treatment cards, which are prepared and kept at the place of diagnosis and treatment. The information from the treatment card is transferred onto the TB Register, which is kept at the sub-district level and is updated from time to time by the Senior Treatment Supervisor (STS). Quarterly reports on case-finding and treatment outcomes are prepared at the sub-district level and sent to the district level for compilation and onward submission to State and Central levels. Analysis of data would take place at district, state and central level and information would flow back to the sub-districts for corrective actions.

The above strategy should be implemented in all the districts of our country as *early as possible to rapidly cut down the chain of disease transmission.* The government of India has sought World Bank assistance to extend DOTS to about 330 million people in the course of the next five years to implement this revised strategy under NTP[17]. The provision and maintenance of uninterrupted drug supply of all anti-TB drugs through strengthening of the existing system shall go a long way in improving compliance and cure rates.

Other suggested inputs needed to intensify TB control efforts are as under:

TB mortality and morbidity would decline only if *increased financial support* is made available each year to TB control programmes in developing countries. A strong political will and advocacy is required to appreciate the enormity of the problems due to TB and to allocate appropriate budgets for TB control programmes. Enhanced finances are needed to enable the TB programmes to undertake training programmes, improve registration systems and monitoring tools, to finance medicines, microscopes and improve the modest infrastructure so that these programmes work efficiently. Additional resources are also required to cater to the increasing number of patients having HIV and TB as these patients may also require expenses due to hospitalization.

Accurate knowledge and increased awareness among the general public especially the high risk groups such as agricultural workers needs to be communicated to remove their misconceptions and modify their help seeking behaviour favourably. They must be educated that TB is curable with complete and regular treatment and that sputum microscopy is the most reliable tool for diagnosing TB. Informing people about the programme must receive the top most priority. Since a sustained awareness programme can go a long way in more and more people reporting for treatment. Community participation in the programme especially in detection and referral of chest symptomatics for sputum examination and supervising treatment must be encouraged.

Increased awareness among the people without strengthening the service delivery would further erode people's confidence in health services. Diagnosis of TB, its treatment and follow-up of patients till they are cured can all be effectively undertaken at the level of PHC. Therefore, *PHCs must be strengthened* in respect of leadership, management, drugs & supplies and record keeping.

Among the health workers, finding more cases is generally considered more important than ensuring cure of those detected. As a result, defaulter retrieval under the programme is not undertaken in sincerity. Appraisal *training of health workers* in a simple demonstrative manner periodically while covering the technical and managerial aspects shall help to tackle the problem of non-adherence to treatment effectively.

Strengthening of operation research and improving the functioning of the existing health care systems, and *roping in of NGOs and private practitioners* to assist control programmes are other essential ingredients to successfully combat the menace of TB.

Improvement in socio-economic conditions of rural populations including agricultural workers will reduce the burden of the disease as has been observed in Western countries where the incidence of the disease declined in the beginning of this century prior to the anti tubercular therapy era.

As TB control programme evolves into the next millenium, the public health community should take all appropriate actions aimed at intensifying the TB control efforts in order to reduce the enormous burden imposed by this disease.

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Table 1: Prevalence of pulmonary TB in rural parts of India

Area & year	Sample size	Prevalence of pulmonary TB/1000 population	
		Bacillary	Abacillary
Madanapalle[8] (1950)	20,307 (all ages)	M – 3.2 F – 1.5	M – 5.8 F – 3.0
National Sample Survey[7] (1955-58)	1,22,907 (> 4 years)	3.44 (2.29 to 6.11)*	16.00
Tumkur district, Karnataka[9] (1960-61)	21,021 (> 9 years)	4.1 M – 5.6 F – 2.5	19 M – 25 F - 12
Rural Bangalore[10] (4 surveys between 1961-68)	41,000-43,000 (> 4 years)	3.4 – 4.0	-
Chingleput (Tamil Nadu)[11] (1968-71)	2,06,609 (> 9 years)	10.68 M – 17.04 F – 4.39	14.29 M – 18.86 F – 9.78
Wardha[12] (1982-88)	4,87,654 (> 4 years)	1.98	-
North Arcot (Tamil Nadu)[13]	18,688 (> 4 years)	2.41 (by smear alone)	-
Rural Bangalore[14] (1984-86)	21,924 (> 9 years)	4.4 M – 6.4 F – 2.3	-
Morena district, Madhya Pradesh[15]	11,097 (> 14 years)	12.7	-
Raichur district, Karnataka[16] (1988-89)	40,000 (> 14 years)	10.7	-

*The prevalence rate varied from place to place in this range.

Table 2: Total TB deaths in rural India by age and sex (000,s)

Age group	Rural areas	
	Males	Females
0 – 4	4.5	1.9
5 – 14	2.5	5.3
15 – 44	85.6	68.8
45 – 59	76.3	28.8
60 +	65.1	27.2
Total TB deaths	234	132

Ergonomics Practices In Agricultural Processes

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Introduction

Application of ergonomics, often referred to as agricultural ergonomics, emerges as a potential discipline for whole ranging application in farming methods and practices. This discipline specifies application of those work sciences relating human performance to the improvement of work system in farming activity. One may perceive the implication of ergonomics based on its generalized principles, however, there are lacunae for application by following any defined rule of thumb. Gradual advances in agricultural management, production and distribution system are indications of transformation of traditional agriculture to industrial bases. Obviously, wide variations in agriculture suggest that ergonomics application would certainly differ with the farm practices. The countries of Asia and Africa, where the society predominantly depends on traditional agriculture, have pressing problems of occupational disease and injury categories due to ergonomics related problems. The exposure to the open field environment and the strenuous physical jobs are only two of the more obvious agricultural ergonomics problem. Alleviation of the rigors at the workplace and to the improvement in performance ability of a person are the ultimate goals and objectives of ergonomics application.

The attainment of the above objective may only be possible by modifying the jobs that people do, reorienting and designing the work places and work spaces, work methods, the tools and the equipment they use and optimizing human exposure to adverse work environment, whereby it promises reduced injuries, improved work performance and productivity. This wholistic view has an implied challenge that the ergonomics should bring about not only the beneficial changes at the workplace but also a method of assessment of the benefits of change. Ergonomics has an important role to generate a great deal of information from traditional farming systems and apply the modern concepts of ergonomics to improve work conditions and work places. Modern technology is gradually finding its place in agriculture, with still large-scale dependence on family scale farming. With the introduction of modern technology, ergonomics becomes essential for its successful application. The important point here is that the major benefit to the agriculture is to have safe, healthy and productive worker. Having recognized that the social costs due to ill health and injuries are real and substantial, it has been viewed that ergonomics, by helping to provide improvement in farming can serve as a dominant scientific discipline for socio-technical development. The philosophy of ergonomic application is generic to the concept of technology application in any sphere of human activity.

Areas Of Ergonomics Application

The practitioners in ergonomics are face to face with stark realities, that is: when, where and how to use ergonomics? That means, ergonomics is important and useful in those work situations when people are present, such as when people operate production systems, when people repair and service equipment and the like. Typically, the application of ergonomics has been largely practiced in the correction and prevention of problems in agriculture. The considerations include the study of human needs, characteristics, abilities and skills as applied to design, production, management, maintenance and in some cases recycling and destruction of high quality and human products or services with a given physical/chemical environment and social surroundings. Agricultural methods and practices vary across national boundaries:

- Industrial agriculture - industrialized countries of the West (temperate climate) and specialized sectors of the tropical Countries.
- Green revolution agriculture-well endowed areas in the tropics, primarily irrigated plains and deltas of Asia, Latin America and North Africa.
- Resource - poor agriculture - hinterlands, dry lands, forests mountains and hills, near deserts and swamps. About one billion people in Asia, 300 million in sub Saharan Africa and 100 million in Latin America are dependent on this form of agriculture.

With distinct agro-climatic features, the farm crops are grouped as follows:

- Field crops (cereals, oil seeds, fiber, sugar and fodder crops) are rain fed or cultivated through controlled irrigation.
- Upland and semi upland cultivation (wheat, groundnuts, cotton and so on) are practiced where irrigation or rainwater is not abundantly available.
- Wet land cultivation (rice crops) is practiced where the land is ploughed and puddle with 5-6 cms. Of standing water and seedlings are transplanted.
- Horticulture crops are fruit, vegetable and flower crops.
- Plantation or perennial crops include coconut, rubber, coffee, tea and so on.
- Pastures are anything nature grows without human intervention.

Farming Operations, Hand Tools And Machinery

Farming in India is labor intensive and estimated that human effort provides more than 70% of the energy required for crop production tasks. Improvement in the existing tools, equipment and methods of work has significant effect in minimizing human strain and fatigue and increasing farm productivity. For field crops, farm activities may be categorized as below:

- **Seedbed preparation** - A suitable seedbed is one that is mellow yet compact and free from vegetation that would interfere with seeding. Seed-bed preparation involves use of different types of hand tools, shallow chisel, Desi or mould board plough pulled by draft animals or tractor implements for blowing, harrowing and so on. About 0.4 hectare (ha) of land can be tilled by a bullock-drawn plough in a day, and a pair of bullocks can provide power to the extent of 1 horse power (hp).

- **Sowing, planting and fertilizer application** - The sowing of seeds and planting of seedlings involve the use of planters, seeders, drills and the manual broadcasting of seeds. About 8% of total person hours are required for broadcasting of seeds and uprooting and transplanting of seedlings. In the broadcasting of seeds/fertilizer by hand, manually operated broadcasters allow uniform distribution with minimum drudgery. Seeding behind a plough consists of sowing of seeds in a furrow opened by a wooden plough. In drilling, seeds are placed in the soil by a seed drill or seed cum fertilized drill. About 1/3rd of the world's rice is grown by the transplanting system. This is also done for tobacco and some vegetable crops. Usually, germinating seeds are broadcasters densely on a puddle field. The seedlings are uprooted and transplanted to a puddle field by hand or with manual or power operated transplanters.

- **Plant protection** - Fertilizer, pesticides, herbicide and other chemical applicators are operated by pressure through nozzles or by centrifugal force. Large scale spraying is based on the hydraulic nozzle, spray atomizer, either manually operated or using tractor-mounted equipment. Knapsack sprayers are scaled down models of vehicle mounted sprayers. A compression knapsack sprayer consists of a tank, a pump and a rod with nozzle and hose. A lever operated knapsack sprayer (10-20 l) has an operating lever. A power knapsack sprayer consists of a chemical tank of about 10-l capacity and an air-cooled engine of 1-3 hp. The sprayer and engine unit is mounted on a frame and carried on the operator's back. A hand operated bucket sprayer and foot-operated sprayer require 2 persons for operating the pump and spraying. When carried on the shoulder for prolonged periods, the vibrations of knapsack sprayers/chemical applicators have detrimental effects on the human body. Spraying using knapsack sprayer results in potential skin exposure (the leg experience 61% of the total contamination, the hands 33%, the torso 3%, the head 2% and the arm 1-%).

- **Irrigation** - Irrigation is a prerequisite for intensive cropping in arid and semi-arid regions. Since time immemorial, various indigenous devices have been used for lifting water. Lifting water by different manual methods is physically strenuous. In spite of the availability of water pump sets (electrical or engine powered), manually operated devices are widely used (e.g. swing baskets, counter poise water lifts, water wheels, chain and washer pumps, reciprocating pumps). Particularly, the swing basket is often used for lifting water from an irrigation channel and the work demands heavy physical activity with adoption of awkward body movements and posture.

- **Weeding and inter-cultivation** - Undesirable plants and weeds cause losses by impairing crop yields and quality, harboring plant pests and increasing irrigation costs. Reduction in yield varies from 10-60% depending upon the thickness of growth and the kind of weeds. About 15% of human labor are spent in removing weeds during the cultivating season. Women typically comprise a large portion of the workforce engaged in weeding. In a typical situation, a worker spends about 190-220 hours weeding one hectare of land by hand or hand hoe. Of several methods (e.g. mechanical, chemical, biological, cultural), mechanical weeding, either by pulling out the weeds by hand or with hand tools like the hand hoe and simple weeders, is useful in both dry and wet land.

- **Harvesting** - In rice and wheat crops, harvesting requires 8-10% of the total person hours used in crop production. Despite rapid mechanization in harvesting, large-scale dependence on manual methods will continue for years to come. Hand tools (sickle, scythe and so on) are used in manual harvesting. The scythe is commonly used in some parts of the world, because of its large area of coverage. However, it requires more energy than harvesting with a sickle. Harvesting accidents, lacerations and incised wounds are common in paddy, wheat and cane sugar fields. The hand tools are primarily designed for right handed persons, but are often used by left-handed users who are unaware of the possible safety implications.

- **Threshing** - Threshing includes separation of grains from the earheads. Age old manual methods of threshing of grain from the paddy pinnacle are: rubbing the earheads with one's feet, beating of the harvested crop on a Plank, animal treading and so on. In manual threshing by beating one separates about 1.6 - 1.8 kg of grain and 1.8 - 2.1 kg of straw per minute from medium sized paddy/wheat plants. Mechanical threshers carry out threshing and winnowing operations simultaneously. The pedal threshers (oscillating or rotary mode) increases the out put to 2.3 -2.6 kg of grain (paddy/wheat) and 3.1-3.6 kg of straw per min. Pedal threshing is a more strenuous activity than manual threshing by beating. Power threshers are gradually being introduced in green revolution areas. Essentially they consist of a prime mover, a threshing unit, a winnowing unit, a feeding unit and an outlet for clean grain. Self-propelled combines are a combination of a harvester and a thresher unit for grain crops. Fatal accidents have been reported in grain threshing using power threshers and fodder cutters. The rotor can injure hands and feet. The position of the feeding chute can result in awkward postures when feeding the crop into the thresher. The belt powering the thresher is also a common cause of injuries. With fodder cutters, the operators can sustain injury while feeding the fodder into the moving blades. Children sustain injury when playing with the machines.

- **Winnowing** - Winnowing is a process to separate grains from chaff by blowing air, using a hand fan or pedal - or motor driven fan. In manual methods the whole content is thrown up in the air, and the grain and chaff get separated out by differential momentum. A mechanical winnower may, with considerable human exertion, be hand or pedal operated. Other post harvest operations include cleaning and grading of grains, shelling, decorticating, hulling, peeling, and slicing, fiber extraction and so on.

- **Manual material handling tasks** - Most agricultural activities involve manual material handling tasks (e.g. lifting, lowering, pulling, pushing and carrying of heavy loads), resulting in musculoskeltal strains, falls, spinal injuries and so on. The fall injury rate increases dramatically when the fall height is more than 2 meters; impact forces are reduced many fold if the victim falls on soft earth, hay or sand. In rural areas, loads weighing 50-100 kg. might be carried several miles on a daily basis. In some Countries, women and children have to fetch water in large quantities from a distance. These arduous tasks need to be minimized to the extent possible. Different modes of load carrying involve carrying on the head, on the hips, on the back and on the shoulder and these have been associated with a variety of bio-mechanical and spinal disorders. In general, optimization of loads that may be lifted or carried would help in minimizing the arduous tasks and its associated risk potentials.

In view of the diversity of farm activities, certain organizational measures towards redesigning of tools and machinery, methods of work, installation of safety guards on machinery, optimization of human exposure to adverse work environment and so on may significantly improve conditions of work for farming populations. Extensive ergonomic research on farm methods and practices, tools and equipment may generate a great deal of knowledge for the betterment of health, safety and productivity of billions of agricultural workers. This being the world's largest industry, the primitive image of the sector, particularly the resource poor tropical agriculture, could be transformed as task oriented. Thus rural workers can undergo systematic training on the hazards of jobs and safe operational procedures can be developed. The safety education at all levels are important, whereby the workers undergo the procedure of systematic learning and hazards of jobs and safe operational procedures are outlined. The success of injury prevention lies in each adult and child knowing the hazards on the farm and doing his best to prevent these accidents.

Pesticide Residues in Food Chain and Their Implications

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Production of food crops in field and subsequent storage suffer heavy losses due to pest infestation more so in tropical countries due to perpetuation of a number of insects and diseases. These losses are quantitative as well as qualitative and account to the tune of Rs.6000.00 crores annually in India (Table 1). Pesticide Chemicals have decidedly been proved to control these losses effectively. However, pesticide consumption in India is still low as compared to developed countries (Table 2). This is mainly due to the importance of their use has not reached to common farmer. Further, these chemicals are costly too. Therefore, only progressive farmers are currently using pesticides under irrigated conditions of crop production. Apart from agriculture use the pesticide use in health program for control of vectors of various diseases has also achieved significance. Among the various pesticides used in the country, insecticides constitute 75%, fungicides 15%, weedicides 6% and others 4%. To date, 144 chemicals are registered with Government of India that come under the category of pesticides possessing insecticidal, fungicidal, nematicidal, weedicidal and molluscicidal properties.

Pesticides being toxic in nature, leave behind their residues when used for pest control. Further their indiscriminate use is creating pesticide pollution of environment in addition to contaminate the food chain as well as non targeted living organisms without much considerations on the implications of possible toxic hazards. The progressive increase in pesticide usage in different crops in India (Table 3), therefore, suggest periodic monitoring of pesticide contamination levels in food chain. The magnitude of pesticide pollution and contamination in food chain comprising of food grains, vegetables, fruits, spices, animal products, air and water in India have been evaluated periodically by various research workers.

Pesticide Residues in food grains and pulses

The food grains of wheat, rice, jowar and pulses e.g.,arhar, mung and gram were found to be loaded with residues of pesticides like DDT, HCH, heptachlor, aldrin and malathion across the country from time to time. The contamination of food grains of wheat, rice and jowar were found in the range of 37.9 to 58.1%, rice grains showing highest contamination. The contamination of pesticide residues in samples of pulses was equally high ranging between 35.9 to 52.94% mainly in arhar, mung and gram. Arhar samples showed highest contamination levels.

The wide spread and higher level of pesticides contamination in food grains is mainly due to pesticide use during storage.

Table 1: Losses due to various pests

Category of pests	Percent Loss	Monetary value in Rs.(crores)
Weeds	33	1980
Plant diseases	26	1560
Insect Pests	20	1200
Rodents	7	420
Miscellaneous	8	480

Source: Sachan (1989). Pesticides in Agriculture. Indian Farmers Digest, 22: 9-13

Table 2: Consumption of pesticides in different Countries

Country	Pesticide consumption (g/ha)
Japan	10,790
Europe	1,870
U.S.A.	1,490
India	336
Africa	127

Source: Sachan (1989). Pesticides in Agriculture. Indian Farmers Digest, 22:9-13.

Table 3: Use of pesticides on different crops in India

	Crops	% pesticide share	% cropped Area
1.	Cotton	52 - 55	5
2.	Rice	17 - 18	24
3.	Fruits & Vegetables	13 - 14	3
4.	Plantation	7 - 8	2
5.	Cereals, Millets, Oil Seeds	6 - 7	58
6.	Sugarcane	2 - 3	2
7.	Others	1 - 3	6

Source: Sachan (1989). Pesticides in Agriculture. Indian Farmers Digest, 22:9-13.

Table 4: Status of Pesticide Residues in Market samples of food

Status of Residues	Percentage of Samples	
	World	India
Above tolerance level	1.20	25.0
Within tolerance level	18.19	72.5
Not detectable	80.00	2.5

Source: Kalra, R.L., Pesticide Residues in Food in India - An Overview, P.A.U. and Ludhiana.

Pesticide Residues in Vegetables

It is of common knowledge that vegetable production involves heavy pesticide use during fruiting and there is very little gap between the pesticide application and harvest. Therefore, wide spread contamination of pesticide residues was observed in most of the vegetable samples. Leafy vegetables have shown highest contamination in cent per cent samples while significantly higher level of contamination was reported in potato and starchy vegetables (57.8 to 76.7%); cauliflower (56.0%); tomato (44.4%); cabbage (32.0%); bhindi (57.1%) and brinjal (57.1%) from different places. Among the various pesticides being used, DDT, HCH, Lindane, heptachlor, aldrin, dieldrin were the main contaminants found persisting.

Pesticide Residues in Fruits

Like vegetables, fruit cultivation to economic production is not possible without effective pest control. Accordingly, heavy pesticide applications are done throughout cropping season resulting in persistence of their residues at harvest also. The monitoring of samples of different fruits from across the country has shown variable pattern of contamination in the range of 24.1 to 100%. Percent contamination in mango fruit samples ranged between 24.1 to 95% while other fruits recorded variable contamination to the extent of 56.6% grapes, 21.0 to 84.6% guava, 23.8% sapota; 85.7% banana; 90.0% apple; 100% plum and 90.9% sweet lemon. Like vegetable contamination organo chlorine pesticides were main contaminants in fruits.

Pesticide Residues in Oil Seeds and Oils

Moderate to very high level of pesticides contamination was recorded in samples of various oil seeds and oils. Accordingly, 56.2% groundnut seeds; 79.5% cotton seeds; 81.8% castor seeds; 40% sesame seeds; 39.3% sunflower seeds and 37.1% safflower seeds were found contaminated with various pesticides. Oil samples were by and large, contained higher and wide spread pesticide residues. A very high contamination was reported in oils of mustard

(93.3%); coconut (100%), groundnut (70.5%), sesame (100%), against safflower (53.8%); vegetable fats (58.7%) and sunflower (12.8%).

Oil seeds and oils in general were contaminated with DDT and HCH residues only.

Pesticide Residues In Animal Products

Animal products as food consisting of milk and milk products, meat, fish and egg samples have also shown wide spread pesticide contamination. Meat samples of goat, sheep, cow/buffalo, pork and chicken were found contaminated at the level of 57.9, 100.0, 41.2, 100.0 and 70.4% respectively as against 66.3% fish and 72.5% egg samples with hard to degrade organochlorine pesticides.

Bovine milk registered high contamination at the range of 64.6 to 91.6%. Milk products like ghee and butter have been found to show 100% contamination. It is alarming to note that 49.8% human milk have also shown pesticide residue contamination.

Pesticide Residues In Spices

The monitoring of spice samples of black pepper, celery seed, dill seed, fennel, ginger and turmeric have shown 100% contamination with pesticide residues of DDT and HCH.

Pesticide Residues In Water

Traces of organochlorine and organophosphate pesticide residues in well, pond and river water have also been reported. The persistence of pesticide residues in drinking water is mainly due to movement of pesticide residues from the site of application. The soil being the final sink of pesticides, whatever way they are being used further transport the residues to water sources.

The magnitude of pesticide contamination of food chain in India can be summarized through the results of a study by FAO, 1984 that all the 1500 samples of cereals, pulses, milk, oil and meat sampled from all over India contained DDT and HCH residues and these residues exceeded the WHO safety limit in 25% samples. In contrast only 1.2% of food samples had residues above tolerance levels in market basket surveys in developed countries (Table 4). Further more, Indian babies imbibe higher quantities of DDT from their mother's milk than American, Swedish and German babies. More recently, a coordinated monitoring study at various centers of All India Co-ordinated Research Project on Pesticide Residues (ICAR) across the country have also established wide spread contamination of food grains, fruits, vegetables, milk, milk products, fishes, meat and animal feed particularly with hard to degrade pesticides like DDT and HCH.

In addition to the adverse effects on human health, pesticides have also polluted water, soil and air mainly due to indiscriminate and injudicious uses. This has therefore led to problems like environmental pollution, bio-magnification of terminal residues, build up of insecticide resistance, destruction of natural enemies of insect pests, resurgence of other species of insects, poisoning of non-targeted organisms like birds, fishes, earthworms etc.

Causes Of Pesticide Residue In Food

In India, maximum exposure of pesticides to consumers has been through vegetables and animal products such as milk, milk products, meat, fish etc. The high residue content in vegetables can be attributed to the frequent pesticide applications and non-compliance of recommended waiting periods. A high residue found in animal product can be attributed mainly to feeding of animals with contaminated feed and fodder with persistent types of pesticides like DDT, HCH etc, which accumulate in body. Surprisingly, at times, far excessive residues have been reported in vegetables and grain samples than obtained even immediately after spraying. In vegetables, this could be attributed to malpractices like dipping of vegetables in pesticide solution for enhancing keeping quality or better appearance. Sometimes, higher doses are used inadvertently, in absence of measuring devices or proper applicator.

Further, the pesticide residue problem in food is more complicated because of the bulk use of organochlorine compounds like DDT & HCH. These are major pollutants and virtually detected everywhere in crop plants, soil, water and animal system including man. Inspite of the extremely low level of pesticides consumption in India, observed residues above the prescribed maximum residue limit are substantially higher than the situation in developed countries.

These are several causes for persistence of pesticide residues in food. The use of BHC in agriculture and uses of DDT in public health programmes are the major contributors to this problem. Other pesticides like, organophosphorus, carbamates and synthetic pyrethroids and even some chlorinated pesticides like aldrin, dieldrin, chlordane, heptachlor, lindane, endosulfan etc., contribute very marginally to residue problem. Basically either the residue is small and specific or the product degrades quickly enough to leave limited residues. However, these are specific situations that result in the build up of pesticide residues in food chain.

1. Excessive and over dose applications at farmer's end

2. Improper use of pesticides not following the scientific recommendations

3. Not following the minimum waiting periods prescribed between pesticide application and harvest

4. Direct mixing of pesticides with grains during storage.

5. Injudicious use of pesticides in and around dairies, vegetable and fruit yards, slaughter houses, fish ponds, flood processing units for control of pests like house flies, cockroaches and carry over infestations.

6. Faulty pesticide residue analysis.

Toxicity Hazards Due To Pesticide Residues And Safety Measures

The toxicity due to pesticides residues, apart from acute effects, produces latent diseases and disorders such as cancer, heart diseases, brain, kidney and lever damage as well as sterility, spontaneous abortions and birth defects. Indians face a much higher risk of above effects as they carry higher quantities of pesticide residues in their body than people in developed countries. The risk from acute or sub-acute toxicity is unlikely to be concern in case of consumers as they seldom come in contact with pesticides directly. The consumer is mainly exposed to pesticides through consumption of contaminated food with toxic pesticide residues. The Government through legislation has enforced many safety factors to ensue that pesticide residues remain below the prescribed maximum residue limit (MRL). These include rate of pesticide application, time of application, number of application and duration between the last application and harvest, commonly called waiting periods.

It is all the more necessary to keep a constant watch on the extent of pesticide contamination of food chain. Therefore, a regular and periodic monitoring of food commodities for the persistence of pesticide residues is carried out and public are cautioned to the possible hazards. In such a case, it will be highly useful to decontaminate the food commodities before consumption at domestic levels through the processes like washing with water, washing with dilute detergent solution, peeling off the fruit skin etc., that can dislodge substantial pesticide residues absorbed over food grains, fruits and vegetables. Further keeping in view the environmental pollution and the adverse effects due to excessive residues following repeated and indiscriminate use of pesticides, the idea of Integrated Pest Management (IPM) was mooted. IPM programs depend on multi component suppression of pest population and restrict the regular prophylactic usage of broad-spectrum pesticides. Therefore, the main component of IPM is not only pest management but also pesticide residue management by reducing pesticide load in order to protect the environment and life from the possible hazards due to toxic pesticide residue.

Pesticides Related Health Problems

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The need of pesticides is well established for protecting the crops from insect pests in agriculture and human health from vector borne diseases in public health programmes. A wide range of insecticides, fungicides, molluscicides, bactericides and herbicides including fumigants are being used in agriculture. In public health programmes pesticides are used to control malaria, filaria, onchrocerciasis, schistosomiasis and trypansomaiasis. As pesticides are inherently toxic to living organisms, they are likely to affect the health of human beings. Concerns about the effects of pesticides on human health have been voiced in a number of reports. The population may be exposed to pesticides in different ways and different degrees. The exposure may be intentional (suicidal, homicidal) or unintentional (occupational or accidental or residues). Only a proportion of population is likely to receive a pesticide dose high enough to cause acute severe effects while approximate size of the population at risk to long term, low level of exposure to pesticides is very high.

Presently about 150 pesticides are registered for use in our country. These are of varied chemical nature and have great difference in their mode of action, uptake by the body, metabolism and toxicity to human beings. Pesticides which have a high acute toxicity but are readily metabolized are eliminated, their main hazard in connection with acute, short-term exposures. However, with those pesticides, which have a lower acute toxicity but a strong tendency to accumulate in the body, the main hazard is in connection with long term exposure. Acute effects are usually easily recognized whereas effects of long term exposures to low doses (viz. pesticide residues in food) are often difficult to distinguish.

Adverse effects due to pesticides are caused not only by active ingredients and associated impurities but also by solvents, carriers, emulsifiers and other constituents of the formulated product. The severity of adverse effects of exposure to pesticides depends on the :

- dose; for most pesticides, a dose effect relationship has been defined.
- the route of exposure. It may be oral, dermal or inhalation.

- its absorption in the body: fat-soluble pesticides are better absorbed through intact, skin than water-soluble pests. The absorption is more from the wet skin and from certain sites like eyes and lips or through abraded skin. High temperature and humidity of the environment facilitates the absorption. The vapors of pesticides or aerosol droplets smaller than 5 μm in diameter are absorbed through the lungs.

- type / nature of its effect: Headache, giddiness, vomiting, salivation, lacrymation, convulsions, allergic reaction, cardiac or respiratory/irregularities etc.

- its accumulation and persistence in the body

- health status of the individual: Malnutrition or dehydration is likely to increase sensitivity to pesticides.

The sign and symptoms of acute poisoning of some group of pesticides are characteristic viz. organophsophorous and carbamate group of pesticides has anticholinesterase activity and therefore exhibit the sign and symptoms of cholinesterase inhibition which include diarrhea, lacrymation, salivation, flushing, miosis, increase in blood pressure, pulse rate, breathlessness, palpitation and in severe cases cardioarrythmias, convulsions and respiratory distress. In cases of organochlorine pesticides (DDT, BHC, endosulfan) which act by altering the transport of Na+ and K+ across axonol membranes, thus causing an increased negative after potential, prolonged action potentials and repetitive firing after a single stimulus, the sign and symptoms of poisoning with high doses which paresthias of tongue, lips and face, apprehension, hypersusceptibility to stimuli, irritability, dizziness, tremor and tonic and clonic convulsions. Synthetic pyrethroids (allethrin, parallethrin, deltamethrin, cyfluthrin etc.) have generally low acute toxicity and therefore considered comparatively safe. Their low acute toxicity is due to their rapid bio-transformation by ester hydrolysis and/or hydroxylation. However, many of these pyrethroids may cause allergic reaction or contact dermatitis. Rodenticide warfarin and bromodiolone act by inhibiting the synthesis of vit. K by liver and therefore interfere with normal clotting mechanism of blood resulting in bleeding from various sites viz. petechiae, malena, haematomesis, haematuria etc. Other group of pesticides may exhibit non-specific sign and symptoms viz. headache, giddiness, nausea, vomiting, tremors. breathlessness etc. on acute exposure.

The chronic effects or effects of long term exposure to pesticides include :

1. Neurological effects :

a) Delayed neurotoxicity : Certain OP compounds eg. leptophos
b) Behavioural changes: Certain OP compounds
c) Lesions of CNS: OP, OC and organomercurials
d) Peripheral neuritis: Chlorophenary herbicides, pyrethroids and certain OP compounds

2. Reproductive effects:

a) Sterility in males : Dibromochloropropane (DBCP)
b) Effect on female reproductive system of animals : Chlorodecon, thiram and ziram.
c) Teratogenicity and fetal toxicity in some animal species: Captan, carbaryl, folpet, organomercurials, benomyl etc.

Pesticides included teratogenicity in animal experiments were usually dose-dependent and the doses required to produce teratogenic effects were much higher than those that of human beings might be expected to receive under normal conditions.

3. Bone marrow effects:

- Aplastic anemia: - blood dyscrasias	Due to idosyncratic bone marrow reactions.

4. Cancer:
International Agency for Research on Cancer (IARC) has evaluated the potential carcinogenicity of a number of pesticides. Ethylene dibromide and ethylene oxide are classified as "probably carcinogenic to human beings" while some other pesticides like DDT, BHC, Chlorophenols, Chlorophenoxy herbicides etc. are classified as "possibly carcinogenic to human beings".

5. Skin effects:

Contact dermatitis Allergic sensitization	DDT, Captafol lindane, malathion, benomyl, paraquat, Zineb

6. Effect on immune system:
Dicofol, trichlorfen and chlorinated pesticides. An increase in IgG and decrease in IgM and C-3 complement levels were seen in 51 exposed workers of chlorinated pesticides.

7. **Cataract formation:** By diaquat.

8. **Optic nerve atrophy:** Methyl bromide OP compounds

9. **Cellular proliferation:** Paraquat

Very limited epidemiological data are available for evaluation of health effects of pesticides on humans. Epidemiological studies of low dose group are difficult, because, the chronic effects are often not specifically associated with pesticide exposure and the exposure or dose levels are often difficult to measure. In addition, the effects take long time to develop in low-dose groups.

In developing countries like India with commercial agriculture, the benefits of the pesticides are better understood than their hazards or adverse effects and many times the farmers are unfamiliar with the associated risks and necessary safety measures. Further, in developing countries the proportion of population dependent on agriculture is generally high, therefore, even if pesticide use is low, relatively more people are involved in the handling of pesticides, or live in areas where pesticides are used in agriculture. Therefore, to minimize the pesticide related health effects, emphasis is required to be placed on the occupational health of the workers in agricultural sector with appropriate medical surveillance. The scope of health problems related to pesticides in the agricultural sector should be defined through appropriate surveys to determine:

a) The types and amount of pesticide used
b) The number, age and sex of the workers exposed.

The medical practitioners should be emphasized about the need to integrate occupational health with public health programmes. A system of priorities should be established, to ensure that available resources are used to solve these problems which are critical and pressing.

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Pesticides And Human Health

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DO WE NEED PESTICIDES?

For nearly half a century agrochemicals have been a boon to man-kind. They have helped to grow more food, over-come crop pests and diseases and even control the scourges like malaria and plague.

In our country, insect pests alone cause serious losses to many of the crops. In 1993, it was estimated that there were losses of Rs.600 crores in Gujarat, Rs.300 crores in Haryana, Rs.50 crores in Andhra Pradesh, Rs.193 crores in Karnataka, Rs.153 crores in Kerala, Rs.116 crores West Bengal and Rs.153 crores in Bihar. Acording to another study made by the Director of Ecology, Punjab Agricultural University, Ludhiana,during 1983, the total estimated losses to crops in India for want of suitable control of field pests come to Rs.3,274.5 crores in 1976 and Rs.5181.2 crores in 1983. These figures, however, also include the grain losses in storage. Likewise, the losses caused by weeds to major crops in India, have been estimated to be approximately Rs.420 crores per annum. The percent reduction to yield of important crops due to weeds is reported to be 16 in wheat, 41.6 in rice, 39.8 in maize, 33.8 in groundnut, 47.5 in cotton and 34.2 in sugarcane. Especially, crops like pulses, mustard and cotton cannot be grown profitably without pest control and use of pesticides.

Pesticides are, therefore, essential to meet the increased food production and in the control of public health programmes.

ARE PESTICIDES HAZARDOUS?

All pesticides are inherently poisonous and have injurious effects on living organism including man and domestic animals. They may cause very simple skin irritation to premature birth or cancer in experimental animals or man. In addition, they may contaminate the soil, water and the environment. They also leave traces (residues) in food which reach the man and domestic animals. Besides, they may also have effects on non-target organisms in the environment.

DO YOU KNOW THE LEGAL CONTROLS ON PESTICIDES?

Two important Central legislations concerned with pesticides are:

- The Insecticides Act, 1968 and the Insecticides Rules, 1971, framed under the said Act.
- The Prevention of Food Adulteration Act, 1954 and the Prevention of Food Adulteration Rules, 1955, framed under the said Act.

The tolerance limits for the residues of pesticides in food or food commodities, are prescribed under this Act. These limits are prescribed based upon the life time data on laboratory animals including chronic toxicity studies.

WHAT IS TOXICITY OF A PESTICIDE?

The injurious effects produced by pesticides are known as toxic effects. The toxicity of a pesticide is the inherent ability of the chemical to cause damage. The hazard, whereas is the possibility of the compound to cause injury. To illustrate sodium cyanide and hydrogen cyanide have the same toxicity but hydrogen cyanide is more hazardous as it is in the gaseous form when compared to sodium cyanide which is in the form of solid.

WHAT ARE DANGERS AND HOW TO ASSESS THE SAFETY OF A PESTICIDE?

A vital question to be answered about any new toxic pesticide is: Does it present dangers to those who will use it? The dangers produced may be immediate or delayed. To assess the acute and delayed effects of a pesticide a series of toxicological tests are carried out on laboratory animals known as short term and long term studies to know all the possible problems from skin irritation to premature birth, cancer etc. Based on the scientific data so generated extrapolation of the possible effects to man, is made. This type of extrapolation of laboratory experimental data to human beings may not be fool proof as there is no animal species that has similar bio-chemical metabolic path ways in man. Another important factor in the evaluation of the toxicological studies is that toxic response of a chemical is species and also route dependant in addition to dose-dependence. However, all the necessary tests are carried out using suitable experimental animals and the data so generated are considered before granting registration for pesticides in the country.

If on scrutiny it is found that the chemical is phytotoxic, non-effective on the target organism or residues in the treated crops/commodities are above the tolerance limits prescribed under the Prevention of Food Adulteration Act, 1954, or toxic to human beings or animals, the product is denied registration under the Insecticides Act.

FEW BASIC CONCEPTS CONCERNED WITH TOXICITY

Insecticide – Within the meaning of the Insecticides Act, 1968, an insecticide means any substance specified in the schedule or to be included in the schedule or any preparation containing any one or more of such substances, if such substance or preparation is intended for the purpose of prevention, destroying, repelling or mitigating any insects, fungi, weeds, rodents or other forms of plant or animal life not useful to human beings.

Toxicity – is the property of a substance that causes any adverse effects in an organism.

Acute toxicity – is the property of a substance that causes adverse effects in an organism through a single short term exposure.

Subacute toxicity – is the property of a substance that causes adverse effects in an organism upon repeated or continuous exposure within less than half the lifetime of that organism.

Chronic toxicity – is the property of a substance that causes adverse effects in an organism upon repeated or continuous exposure over a period of at least half the lifetime of that organisms.

A mutagenic – substance can induce changes in the genetic complement of either somatic or germinal tissue in subsequent generations.

A tetragenic – substance can produce or induce functional deviations or developmental anomalies, not heritable, in an animal embryo or fetus.

A oncogenic – substance can produce or induce either benign or malignant tumor formations in living animals.

Acute oral LD 50 – is the single orally administered dose of a substance, expressed as milligrams per kilogram or body weight, that is lethal to 50 percent of the test population of animals. Note that the LD 50 is specific for each experimental animal and for each route of administration to the animal (e.g., oral, dermal, inhalation, etc.).

Acute dermal LD 50 – is a single dermal dose of a substance, expressed as milligrams pe kilogram of body weight, that is lethal to 50 percent of the test population of animals under test conditions.

Acute LC 50 – is the concentration of a substance, expressed as parts per million parts of a medium, that is lethal to 50 percent of the test population of animals under specified test conditions.

Pesticide Residue – means any substance or substances in food for man or animals resulting from the use of a pesticide. It also includes any specified derivatives, such as degradation and conversion products, metabolites and reaction products which are considered to be of toxicological significance.

Good agricultural practices in the use of pesticides – is defined as the officially recommended or authorised usage of pesticides under practical conditions at any stage of production, storage, transport, distribution and processing of food and other agricultural commodities, bearing in mind the variations in requirements within and between regions, and which takes into account the minimum quantities necessary to achieve adequate control, applied in a manner so as to leave a residue which is the smallest amount practicable and which is toxicologically acceptable.

Tolerance limit – is the maximum concentration of a pesticide residue that is recommended to be legally permitted in or on a food commodity. The concentration is expressed in parts by weight of pesticide residue per million parts by weight of the food or food commodity.

WHAT IS THE IMPORTANCE OF LABEL AND LEAFLET?

The importance of label and the information given in the leaflet cannot be over emphasised. They provide the only method of direct transmission of technical information, instructions and advice for the judicious and safe use of pesticides. The safe and effective use of pesticides entirely depends on the completeness and clarity of the statements made on the label, the users understanding of its instructions and advice, and his compliance with them.

Classification of products by toxicity – Under the Insecticides Rules, the toxicity category into which a formulated product falls is based primarily on its acute oral and acute dermal toxicity to experimental animals and specifically on its acute oral and dermal LD 50 values in rat. However, if toxicological or any other information comes to the notice at any time signifying a greater or smaller hazard to the users than that based solely on LD 50 data in the rat, the product may be ascribed to a higher or lower category or toxicity. Similarly if the product' dermal toxicity is so great as to ascribe it to a higher class than its oral toxicity, the higher and more restrictive category is adopted.

As liquid products are likely to pose more spread and persistency of contamination on the skin or on clothing than the solid products and more rapid absorption into the circulation after contamination of the skin or in the gastro-intestinal tract, they are assessed as per the WHO recommendation as 4 times more hazardous than solid products.

The inhalational route of exposure is of greater importance in the case of fumigants and also products liberated into the working atmosphere as gases or vapours.

Label and leaflet contents:

The product and leaflet are intended to tell the purchaser and user:

- What is in the container.
- Who made or supplied the product.
- Any legal responsibilities applying to the product.
- The restrictions of its use.
- For what biological problems it is to be used.
- How it should be prepared, used and stored.
- What type and degree of hazard it presents.
- What precautions are needed before, during and after use.
- What to do if adverse effects occur.

The required information to be given on the labels and in leaflets may be broadly grouped into the following 3 categories :

1. Product identity

The following factual information is provided on the label.

- Name of the manufacturer.
- Name of the insecticide. (brand name or Trade mark under which the insecticide is sold).
- Registration number of the insecticide.

- Kind and name of active and other ingredients and percentage of each (Common name accepted by the International Standards Organisation or the Indian Standards Institution of each of the ingredients shall be given and if no common name exists, the correct chemical name which conforms most closely with the generally accepted rules of chemical nomenclature shall be given).

- Net content or volume, (The net content shall be exclusive of wrapper or other material. The correct statement of the net content in terms of weight, measure, number of units of activity, as the case may be shall be given. The weight and volume shall be expressed in the Metric System).

- Batch number.

- Expiry date i.e., upto the date the insecticide shall retain its efficacy and safety.

- ***Antidote statement.***

2. Directions for use :

The following details are given in the leaflet accompanying every packing of an insecticide.

- the plant disease, insect and noxious animals or weeds for which the insecticide is to be applied, the adequate direction concerning the manner in which the insecticide is to be used at the time of application;

- ***particulars regarding chemicals harmful to human beings; animals and wildlife, warning and cautionary statements including the symptoms of poisoning, suitable and adequate safety measures and emergency first-aid treatment where necessary;***

- cautions regarding storage and application of insecticides with suitable warnings relating to inflammable, explosive or other substances harmful to the skin;

- ***instructions concerning the decontamination or safe disposal of used containers;***

- ***a statement showing the antidote for the poison shall be included in the leaflet and the label;***

- ***if the insecticide is irritating to the skin, nose, throat or eyes, a statement shall be included to that effect.***

3. Hazards and precautions :

The following particulars are given on the label.

- The label contains in a prominent place a diamond shaped square divided into two equal triangles. The upper triangle contains the symbol and signal word/warning assigned to each toxicity category prescribed under the Rules.

The symbol and warning statements are:

- insecticides belonging to Category I (Extremely toxic) contain the symbol of a skull and cross bones and the word 'POISON' printed in red;

- the statement "KEEP OUT OF THE REACH OF CHILDREN".

- The statement that "IF SWALLOWED, OR IF SYMPTOMS OF POISONING OCCUR, CONTACT PHYSICIAN IMMEDIATELY".

- Insecticides in Category II (highly toxic) contain the worked "POISON" printed in red and the statement "KEEP OUT OF THE REACH OF CHILDREN".

- Insecticides in Category III (Moderately toxic) contain the word "DANGER" and the statement "KEEP OUT OF THE REACH OF THE CHILDREN".

- Insecticides in Category IV (Slightly toxic) contain the word "CAUTION".

- The lower triangle contain the colour specified to each toxicity category under the classification of insecticides.

TREATMENT OF PESTICIDE POISONING

The most single important factor in the management of pesticide poisoning is sound judgement. The emergency personnel who attend to the poisoning cases cannot be expected to know instantly the dozens of modern pesticides, their mechanism of action and the toxic effects they produce. It cannot be expected also of the emergency personnel who attend to the poisoning cases to have all the clinical and laboratory experience needed for the proper management of each case.

1. 0 ORGANOCHLORINE PESTICIDES

Insecticides: Aldrin, B.H.C.,Chlordane, D.D.T., Heptachlor, Lindane and Toxaphene.

Herbicides: Nitrofen

1.2.0 MECHANISM/SITE OF ACTION

Neurotoxic, CNS, Kidney and Liver.

1.3.0 ROUTE OF ENTRY

Ingestion, inhalation and skin.

1.4.0 SYMPTOMS

Nausea, vomiting, restlessness, tremor, apprehension, convulsions, coma, respiratory failure and death.

1.5.0 TREATMENT

- Do not induce emesis if the ingested poison is principally a Hydrocarbon Solvent (e.g.Kerosene).
- Gastric lavage with 2-4 L.tap water – Catharsis with 30 gm.(10 oz) sodium sulphate in one cup of water.
- Barbiturates in appropriate dosages repeated as necessary for restlessness or convulsions.
- Watch breathing closely,aspirate,oxygen and/or artificial respiration, if needed.
- Avoid oils, oil laxatives and epinephrine (Adrenalin) – ***Do not give stimulants.***
- Give calcium gluconate (10% in 10ml, ampules) intravenously every four hours.

1.6.0 LABORATORY TESTS

No simple test, Assay of parent compound or know metabolite in blood, urine, gastric contents or body tissues. Liver function tests.

2.1.0 ORGANOPHOSPHATE PESTICIDES

Insecticides: Acephate, chlorfenvinphos, diazinon, dichlorvos, dimethoate, ethion, fenitrothion, fenthion, formothion, malathion, menazon, methyl parathion, monocrotophos, oxydemeton methyl, phenthoate, phorate, phosalone, phosphamidon, pirimiphos methyl, quinalphos, temphos, thiometon, trichlorphon.

Fungicides: Epiphenophos and kitazin.

Herbicides: Glyphosate.

2.2.0 MECHANISM/SITE OF ACTION

Anticholinesterase/cholinesterase inhibition.

2.3.0 ROUTE OF ENTRY

Ingestion, inhalation and skin.

2.4.0 SYMPTOMS

Mild – anorexia, headache, dizziness, weakness, anxiety, tremors of tongue and eyelids, miosis, impairment of visual acuity.

Moderate – nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis.

Severe – diarrhoea, pinpoint and non-reactive pupils, respiratory difficulty, pulmonary edema, cyanosis, loss of sphincter control, convulsions, coma, and heart block.

2.5.0 TREATMENT

- For extreme symptoms of O.P. poisoning, injection of atropine (2-4 mg. for adults, 0.5-1.0 mg. for children) is recommended, repeated at 5-10 minute intervals until signs atropinization occur.

- Speed is imperative

- Atropine injection – 1 to 4 mg. Repeat 2 mg. When toxic symptoms begin to recur (15-16 minute intervals). Excessive salivation-good sign more atropine needed.

- Keep airways open, Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration if needed.

- For ingestion lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact, wash with soap and water (eyes – wash with isotonic salient). Wear rubber gloves while washing contact area.

- In addition to atropine give 2-PAM (2-pyridine aldoxime methiodide). 1g. and 0.25 g. for infants intravenously at a slow rate over a period of 5 minutes and administer again periodically as indicated. More than one injection may be required.

- Avoid morphine, theophyllin, aminophyllin, barbiturates or phenothiazines.

- ***Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.***

2.6.0 LABORATORY TESTS

- Estimation of cholinesterase in whole blood, plasma and R.B.C.

- p-introphenol and total alkyl phosphate estimation in urine.

- Estimation of parent compounds in gastric contents.

3.1.0 CARBAMATE PESTICIDE

Insecticides: Aldicarb, carbaryl, carbofuran, propoxur.

3.2.0 MECHANISM/SITE OF ACTION

Anticholinesterase/cholinesterase inhibition.

3.3.0 ROUTE OF ENTRY

Ingestion, inhalation and skin

3.4.0 SYMPTOMS

Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhoea, epigastric pain, tightness in chest.

3.5.0 TREATMENT

- Atropine injection 1 to 4 mg. Repeat 2 mg. When toxic symptoms begin to recur (15-60 minute intervals). - Excessive salivation – good sign, more atropine needed.

- Keep airway open. Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed.

- For ingestion, lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact wash with soap and water (eyes – wash with isotonic saline). Wear rubber gloves while washing contact area.

- Oxygen

- Morphine, If needed.

- Avoid theophyllin and aminophyllin or babiturates.

- 2-PAM and other oximes are harmful and in fact contra indicated. .

- ***Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.***

3.6.0 LABORATORY TESTS

- Cholinesterase estimation in whole blood, plasma and R.B.C.

4.1.0 COUMARINS / INDANDIONES

Warfarin, coumchlor

4.2.0 MECHANISM/SITE OF ACTION

Anticoagulant.

4.3.0 ROUTE OF ENTRY

Ingestion

4.4.0 SYMPTOMS

- After repeated ingestion for several days: bleeding from nose, gums, and into conjunctiva, urine a nd stool.
- Possible pallor and petechial rash, late-massive echymoses or hematoma of skin, joints, brain hemorrhage.
- Shock and death.

4.5.0 TREATMENT

- Lavage stomach with tap water. Catharsis 30 gm. Sodium sulfate in 250 cc tap water.
- Vitamin K (mephyton or menadione preparation) by mouth, intramuscularly or intravenously.Vitamin C may be useful adjunct.
- Transfuse with fresh blood if bleeding is severe or until anemia is corrected.
- Iron (ferrous sulfate) by mouth for correction of secondary anemia, 0.3 gm. t.i.d.

4.6.0 LABORATORY TESTS

Prothrombin activity of blood plasma.

Blood in urine and faeces.

5.1.0 ORGANIC ACIDS

2,4-D

5.2.0 MECHANISM / SITE OF ACTION

Liver, Kidney

5.3.0 ROUTE OF ENTRY

Ingestion

5.4.0 SYMPTOMS

- Weakness and perhaps lethargy, anorexia, diarrhoea, muscle weakness- may involve the muscles of mastication and swallowing.
- Ventricular fibrillation and/or cardiac arrest or death.

5.5.0 TREATMENT

- For ingestion, lavage stomach with tap water. For skin contact, wash exposed area.
- Supportive treatment.
- Quinidine sulfate or quinine to relieve myotonia or suppress abnormal ventricular cardiac rhythm.

5.6.0 LABORATORY TEST

No simple test. Only complex laboratory procedures.

6.1.0 HALOGEN FUMIGANTS

Methyl bromide

6.2.0 MECHANISM / SITE OF ACTION

Kidney, CNS depressant

6.3.0 ROUTE OF ENTRY

Ingestion, inhalation, skin.

6.4.0 SYMPTOMS

- Appear after four to twelve hours following inhaation. Symptoms include dizziness. headache, anorexia, nausea, vomiting, and abdominal pain. Lassitude, weakness, slurring speech and staggering gait. Mental confusion, mania, tremors and epileptiform convulsions.

- Rapid respiration, pulmonary edema, cyanosis, collapse, and death, coma, areflexia, and death due to respiratory or circulatory failure, late manifestations may include bronchopneumonia, pulmonary edema, and respiratory failure. Methyl bromide may produce cutaneous blisters and kill via dermal exposure.

6.5.0 TREATMENT

- In methyl bromide poisoning, early treatment with BAL (British Anti-Lewisite) may be considered if given before symptoms appear.

- First remove patient from contaminated area.

- Remove all contaminated clothing and wash contaminated skin. ***Can penetrate ordinary rubber gloves.***

- Restrain confused and maniacal patients. Barbiturates for convulsions.

- May require specific therapy for acidosis, pulmonary edema, bronchospasm, (use epinephrine subcutaneously), respiratory paralysis and/or kidney failure.

6.6.0 LABORATORY TEST

No simple test. Blood electrolytes to detect acidosis.

7.1.0 CYANIDE FUMIGANTS

Hydrocyanic acid

7.2.0 MECHANISM/SITE OF ACTION

Cell Metabolism

7.3.0 ROUTE OF ENTRY

Ingestion, inhalation

7.4.0 SYMPTOMS

- One of the fastest acting known poisons.
- Massive dose – unconsciousness and death without warning. Smaller doses – illness may last one or more hours.
- Following ingestion, bitter, acrid, burning taste followed by constriction of membrane in throat.
- Salivation and nausea without vomiting, anxiety, confusion, and dizziness.
- Variable respirations – inspiration short and expiration prolonged.
- Odor of bitter almonds in breath and vomitus. Initial increase in blood pressure and slowing of heart followed by rapid and irregular pulse, palpitation, and constriction of chest.

7.5.0 TREATMENT

- If apneic, start artificial respiration. Keep airway open.
- Inhalation of amyl nitrite (amyl nitrite perels) every 15-30 seconds while 3% sodium nitrite solution is being prepared.
- Intravenous injection (even of non-sterile solution) of 10 ml. Of 3% sodium nitrite 2-4 minute period. Do not remove needle.
- Through same needle give 50 ml of 25% solution of sodium thiosulfate over 10 minutes.
- If symptoms recur, repeat the nitrite and thiosulfate.

- Stomach lavage with 1:5000 potassium permanganate should follow the above procedure.

- Oxygen therapy and whole blood transfusions may be necessary if nitrite induced methemoglobninemia becomes severe.

7.6.0 LABORATORY TESTS

No simple test. Send blood to lab. For cyanide levels.

8.1.0 **PHOSPHINE FUMIGANTS**

Aluminium phosphide.

8.2.0 **MECHANISM/SITE OF ACTION**

Lungs

8.3.0 **ROUTE OF ENTRY**

Inhalation

8.4.0 **SYMPTOMS**

- Nausea, vomiting, diarrhoea, great thirst, headache, vertigotinnitus, pressure in chest. back pains, dyspnea, a feeling of coldness, and stupor or attacks of fainting. May develop cough, sputum of a green fluorescent colour.

- Chronic poisoning may be characterised by anemia, bronchitis, gastrointestinal disturbances, dental necrosses, and disturbances of vision, speech and motor functions.

8.5.0 TREATMENT

No specific antidote. Keep patient quiet and warm. May need to treat incipient pulmonary edema with venesection, oxygen, and hypertonic glucose (50%) infusions. ***Intravenous isotonic solutions are contra indicated.***

8.6.0 LABORATORY TESTS

None.

9.1.0 ARSENICALS

Sodium arsenite

9.2.0 MECHANISM/SITE OF ACTION

Cell metabolism

9.3.0 ROUTE OF ENTRY

Ingestion, inhalation

9.4.0 SYMPTOMS

- Thirty minutes to many hours, vomiting, profuse painful diarrhhea – bloody later, colicky pains in esophagus, stomach and bowel, dehydration, thirst, muscular cramps, cyanosis, feeble pulse and cold extremities, headache, dizziness, vertigo, delirium or stupor, skin eruption, convulsions.

Three terminal signs:

- Coma
- General paralysis
- Death
- chief initial symptoms of ingestion are those of violent gastroenteritis, burning esophageal pain, vomiting, watery or bloody diarrhoea containing much mucous, later collapse, shock, marked weakness. Death generally due to circulatory failure.

- Inhalation: may cause pulmonary edema, restlessness, dyspnea, cyanosis and foamy sputum.

9.5.0 TREATMENT

- For ingestion lavage stomach with 2-3 L. of tap water and instill a glass of milk or a 1% solution of sodium thiosulfate. For skin contact, wash with soap and water. Acute symptoms will not develop except for sodium arsenite.

- Saline cathartic (15 to 30 gm).

- BAL in a 10% solution in oil – instramuscularly:

- Dosage schedule for BAL-(British Anti-Lewisite Compound) (2,3 – Dimercapto –1 – Propanol or Dimercaprol).

Severe Poisoning:

1st day – 3.0 mg/Kg q4th (6 Inj.)
2nd day – 3.0 mg/Kg q4th (6 Inj.)
3rd day – 3.0 mg/Kg q4th (4 Inj.)

Each of following ten days (or until recovery).

3.0 mg/Kg q12 (2 Inj.)

Mild poisoning:

2.5 mg/Kg q4th (6 Inj.)
2.5 mg/Kg q6th (4 Inj.)
2.5 mg/Kg q12th (2 Inj.)

- Check blood pressure and treat shock.

- Isotonic saline for intravenous use to counteract dehydration.

- Morphine may be needed for abdominal pain.

9.6.0 LABORATORY TESTS

No simple test. Save initial stomach contents and urine for arsenic analysis. Urine may show red blood cells, albumin and casts. After arsenic inhalation, urine shows hemoglobin.

PUBLIC HEALTH IMPORTANCE OF PESTICIDE RESIDUES

1.0.0 BACK – DROP

1.1.0 Pesticide residues in or on food and in the total environment are of great concern to the scientific, governmental, industrial and public agencies.

1.2.0 Many national governments have enacted laws regulating pesticide residues in or on food, agricultural commodities or animal feed.

1.3.0 The basic objectives of regulating pesticide residues are:

(a) public health protection or consumer safety and
(b) prevention of environmental pollution.

1.4.0 Pesticide residues regulation has got three aspects:

(a) Legislation

(b) Setting Pesticide "Tolerance Limits" or "Maximum Residue Limits" (MRLs) and

(c) Monitoring of residues in food and feed by residue analysis to ensure and enforce compliance with recommended tolerance limits.

GUIDELINES FOR PREDICTING DIETARY INTAKE OF PESTICIDE RESIDUES

1. ACCEPTABLE DAILY INTAKE AND MAXIMUM RESIDUE LIMITS

The acceptable daily intake (ADI) of a pesticide is established on the basis of a complete review of the available data (biochemical, metabolic, pharmacological, toxicological, etc.) from a wide range of experimental animal studies and observations in humans. The no-observed-adverse-effect level (NOAEL) for the most sensitive toxicological parameter, normally in the most sensitive species of experimental animal, is used as the starting-point. A safety factor that takes into consideration the type of effect, the severity or reversibility of the effect, and the problems of inter-and intra-species variability is applied to the NOAEL to determine the ADI for humans. Pertinent human data may outweight experimental animal data in the estimation of the ADI for man.

2. PREDICTING THE DIETARY INTAKE OF PESTICIDE RESIDUES

General considerations

In order to reach a conclusion as to the acceptability of an MRL from a public health point of view, it is necessary to predict the dietary intake of pesticide residues resulting from application of the MRL, and to compare this prediction with the ADI. The dietary intake of any particular pesticide residue in a given food is obtained by multiplying the residue level in the food by the amount of that food consumed. Total intake of the pesticide residue is then obtained by summing the intakes from all commodities containing the residue concerned.

Indices of residue level

Several indices of residue level can be used to predict pesticide residue intake. The MRL is one such index and represents the maximum residue level that is expected to occur in a commodity following the application of a pesticide according to good agricultural practice. Factors that may be taken into consideration when choosing an index to be used in predicting pesticide residue intake include the residue levels found in practice, their distribution in the commodity, and the effect on residues of the various processes used in the preparation of food.

It should be appreciated that the use of the MRL in the prediction of pesticide residue intake will lead to an overestimation of actual pesticide residue intake .

The prediction of intake of a particular pesticide residue should include all commodities for which MRLs have been established, unless the value has been estimated to be at, or about, the limit of determination.

Indices of food consumption

There are several possible indices of food consumption, a commonly used index being the average daily consumption. Others include average portion sizes, percentile consumption values, and the average consumption by people who actually eat the commodity. In predicting pesticide residue intake an effort should be made to reflect long-term food consumption habits and not day-to-day variations, in order to permit a valid comparison with the ADI, which is based on acceptable intake over a lifetime. Thus, it is recommended that average daily food consumption values be used in predicting pesticide residue intake for comparison with the ADI.

Food consumption patters vary considerably from country to country and even within a country; thus, to a large extent, individual countries will have to estimate their own consumption pattern.

In order to predict pesticide residue intake at the international level, hypothetical diets will need to be developed for a number of dietary patterns that are representative of various regions of the world ("cultural" diets). As a first approximation, a hypothetical global diet consisting of the highest average value of food consumption for each "cultural" diet may suffice. Selection of this value for individual commodities from each "cultural" diet will, however, result in an unrealistic total food consumption. For the prediction of pesticide residue intake, these values should be normalized to a total daily consumption of 1.5 Kg of solid food, i.e., excluding the liquid content of juices or milk.

For more realistic predictions, the "cultural" diets should be used individually. This would make it possible to predict a range of potential intakes.

For predictions of pesticide residue intake carried out at the national level, the best available food consumption data should be used. Countries should be cautious in the use of food consumption values other than average values, if such use results in a hypothetical level of consumption that would not be attained in practice. In carrying out predictions of pesticide residue intake for identifiable subgroups, e.g.,vegetarians, it would be appropriate to use relevant average food consumption data for such subgroups.

Assessment of intake

Pesticide residue intake through the diet can be predicted with different degrees of accuracy. However, the more realistic predictions involve the consideration of many factors and therefore may be rather time-consuming. The options in the process are shown :

1. Options for the prediction of dietary intake of pesticide residues

Measured pesticide residue intake
"Best estimate" – estimated daily intake (EDI)
"Intermediate estimate" – estimated maximum daily intake (EMD)
"Crude estimate" – theoretical maximum daily intake (TMDI)

The procedure discussed here start with the most exaggerated and proceed towards more and more realistic intake predictions. It should be noted that the less realistic predictions, which are relatively straight forward to carry out, give an overestimate of the true pesticide intake. By starting with the most exaggerated predictions, it is therefore possible to eliminate at an early stage pesticides whose intake is clearly unlikely to exceed the ADI. More realistic predictions using refined data then make it possible to eliminate other pesticides from further consideration. Such an approach would facilitate acceptance of MRLs for the majority of pesticides and allow the national authority concerned to direct its attention to those most likely to be of public health concern. The three-tier approach to predicting pesticide residue intake is outlined :

2. Outline of procedures for predicting pesticide residue intake

	TMDI[a]	EMDI [a]	EDI [b]
Residue level	Codex or national MRL	Codex or national MRL Corrections for: (i) edible portion; and (ii) losses on storage, processing and cooking	Known residue level Corrections for: (i) edible portion; and (ii)losses on storage, processing and cooking
Food Consumption	Hypothetical global National diet	"cultural" or National Diet.	National diet
	All commodities with a Codex or National MRL	All commodities with a Codex National MRL	Known use of Pesticide, taking account of : (i) range of Commodities; (ii) proportion of crop treated; and (iii) home-grown and imported crops.

[a] May be estimated at either the national or international level.
[b] Can be estimated only at the national level.

" The safety issue can never be settled by polemics or by fiat. In the ultimate analysis the good health of our farmers and the wholesomeness of our food supply can be guaranteed only by a scientific and medical community that stays alert ".

-DR.ROBERT E. GOSSELIN

Further Suggested Reading:

1. Dr. D.P. Nag, Know Your Pesticides – Technical Report, 1985
Publ: Directorate of Plant Protection, Quarantine and Storage, Govt. of India.

2. Dr. D.P. Nag, Treatment of Pesticide Poisoning – Technical Report, 1985
Publ: Directorate of Plant Protection, Quarantine and Storage, Govt. of India.

3. FAO/WHO (1998) : Pesticide Residues – 1998 Evaluations.

4. FAO/WHO (1999) : Dietary Intake of Pesticide Residues.

CHALLENGES OF AGRICULTURAL MEDICINE FOR THE PHC DOCTOR

by

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CHALLENGES OF AGRICULTURAL MEDICINE FOR THE PHC DOCTOR

A) THE CONTEXT

1. The Agricultural Worker forms more than 70 per cent of the working population in almost all countries of Asia. In India, in the 1981 Census, 42.06 percent were cultivators, 26.31 per cent were agricultural labourers and 2.22 per cent were engaged in plantations, livestock and forestry, bringing the total employed in agriculture and related operations to 70.6 percent. The pattern in the 1991 Census was not very different.

2. Reviews of Occupational Health Research in India and worldwide show however that agricultural work is one of the most neglected areas of research and compared to the amount of information on industrial workers and hazards of industrial environments, there is little information on Hazards of agricultural related occupations. Since the seventies, however, this situation is beginning to change.

3. Agriculture today is becoming a new focus of health research because of a series of factors.

   a) Largest work-force

   In spite of mechanization and industrialization of Agriculture in the west, and the transfer of the so-called Green Revolution technology to the Developing World, **Agriculture continues to remain the main occupation of a large majority of the workers of the world.**

   b) **Modernization of traditional agricultural practices.** This has included a combination of the following developments:

   - improvement of irrigation facilities by construction of dams and canal systems;
   - introduction of High-yielding varieties of seeds for foods and cash crops;
   - increased use of agrochemicals - both fertilisers and pesticides;
   - a genetic upgradation of livestock;
   - a shift from subsistence economy to cash cropping including a shift from produce for local use to produce for export;
   - increasing mechanization of agriculture;
   - a diversion of land resources to generate raw materials for the concomitant industrialization.

   Whereas, it was assumed that increasing GNP of the country and the purchasing power of rural poor would be the results of massive high-technology agricultural development and that this would improve health and nutrition of the people - this equation proved to be more complicated in actual practice.

c) Occupational Hazards and Social costs of Agricultural Development

An increasing number of studies have begun to indicate that the side-effects and social costs of many agricultural policies are detrimental to health. These detrimental social costs documented today include

- occupational and environmental dangers of pesticide use and overuse;
- changes in vector ecology, environment and disease patterns in the community;
- the increase in disabling accidents;
- the marginalisation of the rural poor;
- the deterioration in the quantity and quality of the local diets;
- the dangers from mycotoxins;
- the resurgence of old diseases like malaria and the spread of new ones like Japanese encephalitis.

Occupational health hazards in Agriculture is thus a complex mosaic of not only the known hazards of traditional agricultural practices but the newer and ever increasing hazards of modernization and industrialization of agriculture. **The challenge of Agricultural Medicine is therefore very complex.**

d) Complexity of work environment

Unlike the industrial environment where it is easy to define jobs and identify localised risks and study hazards to health usually in adult subjects, the Agricultural environment is very complex and needs a more complicated research methodology and a more complex health care management. The study of hazards in agriculture is complicated by:

- the plurality of a worker's job;
- the participation of most members of the family in work including women and children;
- the seasonality in the quantity and quality of work;
- and, the multiplicity of hazards affecting a stratified community of landed farmers and landless labourers differently.

This complex situation needs a research methodology very different from those employed in Industrial medical research. The methodology has to be multifactorial, multivariate, interactive, explorative and participatory. It is only in recent years that these methodologies have developed and hence the resurgence of research in Agriculture. Some years ago, efforts were made to evolve a framework to understand the effects of Agricultural development on vector borne diseases. (See additional background paper entitled "Epidemiological patterns associated with Agricultural activities in the tropics", which highlights some aspects of the complexity of this framework.)

This complex situation also demands a multidimensional understanding among the practitioners of Agricultural Medicine and a multidimensional response of the Health Care System to tackle the problems of Agricultural Medicine and Health.

B) THE CHALLENGES OF AGRICULTURAL MEDICINE

1. Key issues

This course will cover a wide range of challenges. A list of 15 key issues that can be a check list for you to identify and classify the potential challenges (Adapted from M.J. Coye, 1988) is enclosed.

1. The industrialisation of Agriculture and the epidemiology of agricultural change
2. The increasing role of hired, seasonal and migrant labour and their epidemiological significance
3. Mechanisation of Agriculture
4. Chemicalisation Agriculture
5. Emerging knowledge of 'Health status' of Agricultural workers or sub-groups.
6. Malnutrition and other nutritional deficiency.
7. Agricultural accidents.
8. **Illness groups**
   a) Mortality
   b) Musculoskeletal disorders
   c)Heart stress syndromes
   d) Dermatitis
   e) Pesticide related illness
   f) Vector borne diseases and zoonoses
   g) Cancers
   h) Psycho-social effects
   i) Other diseases.
9. Inadequate worksite sanitation and Health and Safety Systems.
10. Inadequate `Rights to Know' and social security.

All these are challenges today, in the Indian Agricultural scene as well.

2. Case studies

A series of 8 case studies from literature in the 1970s and 1980s is presented below as an indication of the problems and challenges that were predicted more than two decades ago. **Are we continuing to neglect these problems?**

1. Pesticide Hazards

"Pesticides are of immense value to our agricultural and public health programmes for increasing production and for controlling vectors of certain diseases. No accurate data are available on the morbidity and mortality from these toxicants. However, the records of health and agricultural departments of different states and union territories as summarised in the Council of Agricultural research of 1967 indicate that pesticides have been responsible for various toxic effects in human beings and live stock"

- Indian Council of Medical Research (1975)

2. Japanese Encephalitis

"Japanese encephallitais is caused by a virus carried by a species of culicine mosquito which breeds in the standing water of paddy fields. With increase in the area of rice cultivation, multiple cropping and flooding of more land, the habitat of the mosquitoes has increased. This has leads to a marked increase in their population and the incidence of Japanese encephalitis."

- Ministry of Health and Family Welfare 1975

3. Epidemic Genu Valgum

"Water seepage from the reservoir of the Nagarjunsagar dam and its canals have increased the level of subsoil water. This in turn, has changed fluoride, calcium, molybdenum (Mb), zinc and magnesium composition of the soil. This has resulted in a suitable condition for higher intake of Mb by sorghum plants. For people consuming sorghum a staple, this has meant higher intake of Mb and as a consequence high copper excretion leading to copper deficiency". Associated with high fluoride intake - skeletal fluorosis has been endemic in this area - now this has meant an acute epidemic of genu valgum - knock knees".

Indian Council of Medical Research (1977)

4. Mycotoxins

"The danger from mycotoxins is specially high in developing countries of the world because of climatic conditions which are favourable for mould growth and inadequate pre- and post-harvest practices which promote elaboration of toxins in staple foodgrains. Also, widespread under-nutrition in these countries may render the population more susceptible to hazards of mycotoxins".

Indian Council of Medical Research (1978)

5. **Handigodu Syndrome**

"In 1975, health authorities in the Malnad area of Karnataka in South India began to report a mysterious new disease. For the victims, it began with intermittent pain in the hip and knee joints which later became continuous until some could hardly stand up. This crippling deformity – Endemic Familial Arthritis of Malnad (EFAM) appears to be limited to pesticide use. The people affected by EFAM were all poor people of low caste. At certain times of year especially when food is short the poorer villagers eat crabs which are found in the rice fields.... These same paddy fields were increasingly contaminated with pesticides including parathion and endrin. Due to inbreeding and special genetic characteristics, the people of Malnad were particularly susceptible to the apparent effects of pesticides residues in the environment, consumed via the paddy field crabs".

Indian Council of Medical Research (1980)

6. **Malnutrition**

"Although most Third World countries are basically agricultural, the existing patterns of agricultural development have resulted in inadequate food supply - which means that a large proportion of essential foods ae imported. Moreover, food distribution within these countries is highly unequal, with the richer families in the rural areas and the urban middle and upper classes consuming a disproportionately greater share of the food supply. The poor including the food producers themselves, consequently suffer a deterioration in both the quantity and quality of their food intake".

- Third World Network (1985)

7. **Agricultural accidents**

"An official estimate states that about 1,000 farmers are injured throughout the country during the wheat harvesting season. The chief culprit is the thresher. The largest government hospital in Delhi admitted 2,000 such patients between 1979-81 and 117 returned without a limb. A recent survey by the Department of Agriculture showed that overall rate was 25 accidents per thousand machines."

Medico friend circle (1986)

8. **Malariogenic Development**

"Besides development of insecticide resistant mosquitoes and drug resistant organisms, environmental changes brought about by canal irrigation led to waterlogging and the formation of puddles which were good breeding grounds for mosquitoes. Similarly, a study form Tamilnadu shows that Sathanur reservoir and vicinity accounts for 51% of all the malaria cases in the state. The heaviest concentration of cases is found in villages situated within 5 kms of the river. Most of these villages were free from malaria for nearly twenty years".

- Medico friend circle (1986)

C) SOME GUIDELINES ON `AGRICULTURAL MEDICINE" FOR THE PHC DOCTOR - TO MEET THE CHALLENGES

* As a PHC Doctor, you are part of the Primary Health Care strategy of the government which includes First Line clinical care, Mother and Child Health, Family Planning, Communicable Disease Control, Health Education, School Health, Environmental Sanitation, Vital Statistics and Management Information Systems, establishing referral systems and enabling community organisation and participation.

* However, since the culture/economy of the Rural areas is so closely linked to Agriculture and Agricultural development - the Health problems of Agriculture and the 'positive' and 'negative' effects of Agricultural development will be an area of growing importance in your work. 'Agricultural Medicine' will therefore emerge as a growing challenge in your work.

* To prepare you for this challenge a 6 point guideline is suggested:

   1. **As a Doctor working in a Rural Area, you should take a healthy interest in Agriculture and the changes that are taking place in it over the years, in your areas. This could include:**

      i. **What are the crops being grown in your area?**
      food crops or cash crops? and the balance between them

      ii. **What is the type of irrigation in the area**?
      Does this predispose to any particular type of vector borne disease or health problem? Malaria, Filaria, JE, Guinea worm?

      iii. **What are the chemicals being used for agriculture in your area**?
      Pesticides, Fertilizers, Herbicides, other chemical agents.

      Are there any problems with chronic handling of these?
      Are there acute hazards in their use/over use/misuse?
      Are they commonly used for suicide? Poisoning?

      iv. **What is the type of land ownership and land use patterns in your area? and the system of minimum wages? bonded labour?**
      Do they predispose to increasing poverty, malnutrition, economic insecurity, marginalisation? Are there seasonal patterns? Do these determine illness patterns that you see in your OPD?

2. Keep your Eyes/Ears/Minds open to unusual patterns of disease or emerging medical/health problems.

(i) Are there new patterns of disease? new symptom complexes? unusual case presentations of known disease? New `Mystery' disease? Unusual types of recurring accidents or injury?

(ii) What are people saying about local illness patterns? What linkages are mentioned? Do specific occupational sub-groups mention specific or special problems?

(iii) Can these new patterns or occurrences be linked to any specific local development in agriculture? Climate change? development change?

3. Disaggregate your routine collected Health statistics and check patterns and ask why?

- look at differences in class, caste, land ownership, income, gender, geographical distribution, etc.

  High mortality or morbidity in special sub groups may be due to a special health problem related to local occupations.

4. Keep yourself well informed about changing patterns of known problems and dynamics and nature of new emerging medical/health problems and what can be done at primary health care level?

- The sources of information are many - newspapers and popular magazines; TV and radio, professional journals, CMEs by professional associations.
- Don't be a passive recepient off information. Actively seek and search for relevant materials.
- Write to resource centres, medical college, health directorate, professional associations for information/guidelines.
- Do not rely only on what the Medical representatives say.
- Do not let `market forces' and market economy' determine your choice of action or solutions - but technical factors, cost to patient; effectivity; and other rational factors should determine choice.

5. Inform authorities about observations, impressions; inferences; concerns

- These authorities should not only be the Health directorate, but other departments as well as in an intersectoral context - Agriculture, irrigation, education, women's development; child welfare; panchayatraj; rural industry and so on.

- Write to medical colleges, research institutions, professional associations? You are their eyes/ears at the grass root levels?

- Do not just be passive recepient of expert guidelines or prescriptions from top down processes'. Give feedback or suggestions on local adaptations; local modifications of guidelines; new guidelines, alternative guidelines.

6. **Develop knowledge skills and attitudes in your health team that will help your team to tackle problems of Agricultural Medicine at the PHC level at primary, secondary or tertiary levels of prevention**

- do you know the antidotes to the common chemical poisons available in the rural area
- is your lab geared to make basic lab diagnosis for common priority problems?
- are you including awareness raising or information on some chemicals etc. in your health education programmes
- are you prepared for disasters such as seasonal epidemics, drought, floods and so on.
- if you were requested to give a health impact assessment of a agricultural/rural industries development strategy/programme in your area, do you know the basic protocol of investigations to give such an expert view
- is your team skilled in organising the community using local leadership to enhance the participation of the local community in your programme and initiatives.

In conclusion,

This comprehensive course organised by Regional Occupational Health Centre is a significant opportunity to develop this knowledge and expertise and be sensitised to emerging health challenges. It has included -

Occupational health problems of agriculture; respiratory problems among sericulture workers; occupational lung disease; grain dust problems; TB; Ergonomic problems; pesticides; occupational cancers; Alcoholism; surgical wounds; problems of poultry workers, and dairy workers; problems of safety; cardiac diseases; problem of coir, agarbathi, tea plantations and a wide range of issues. This is a very comprehensive sensitization process. Your active interest and concern to develop this field further is urgently required.

From a Primary Health Centre Doctor to a well informed practitioner of Agricultural Medicine - Are you ready for this metamorphosis as we reach 2000 AD? The challenge is an opportunity!

Further Reading:

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Cancer Scenario in Rural India with a Brief Review of Cancers in Farm and Agricultural Workers.

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Many of the studies in the field of cancer epidemiology/registration in India have been confined to the urban population mainly due to non-availability of sufficient data on cancer incidence in rural population. The National Cancer Registry Program (NCRP) of Indian Council of Medical Research has got only two rural registries, and as of now validated data is available from only one of them. Thus, there is very little available for the researchers interested in observing cancer patterns in a rural population. As, an alternative, this study uses the data on permanent place of residence collected by Hospital Cancer Registries (HCRs) under NCRP. The patients registered at different HCRs were classified by, type of residence whether urban or rural with the help of list of towns categorized as such by census of India 1991 and the directory of postal index numbers (PIN) published by Department of Posts, India. The objectives of this study are to study the differentials by type of residence in relative magnitude, diagnosis and clinical extent of disease in cancer patients of leading sites.

This study uses the data collected by Hospital Cancer Registries (HCR) to determine differences if any, in the pattern of cancer according to type of residence whether urban or rural. The definition of 'urban/rural' was obtained from the publications of the Census of India and the list of towns provided in it were matched with the list of Post Offices in the respective states to get pin codes. The HCR proforma provides information on the PIN codes of residence of patients. These were matched using computer programs to obtain urban/rural divide of patients and the cancer pattern through relative frequencies were obtained.

Three registries namely, Bangalore, Madras and Trivandrum located in Southern part of the Country were included in the study. The proportion of urban/rural cases were 83%, 62% and 42% respectively. The total number of cases for analysis was 91521. The ranks of 5 leading states of cancer remained more or less the same in both urban and rural populations in either sex in three HCRs. However, when one looked closely at the figures of relative frequencies (percentages) a higher proportion (2 - 5 %) of cancers of the oral cavity was observed in the rural population of all the HCRs and in both sexes. A six- percent higher proportion of cervix cancers was observed in the rural population of HCR Madras. Both HCR Madras and Trivandrum showed a higher proportion (5 and 3.5% respectively) of cancer of the breast in the urban population compared to the rural population. The proportion of patients with advanced or localized disease showed some variation between urban and rural areas for certain sites. For example, rural population had higher proportion of advanced oral cancers and the urban had higher localized cancers of the breast in Bangalore.

Insecticides in general and carbamates and phosphates in particular (ORs 2.5 CI: 1.1 - 5.6; 3.08, 1.1 - 9; 3.0,1.3-6.9) showed a significant risk for CLL and low grade NHL (Nanni et al). Kristensen et al have reported a significant association between dairy farming and acute leukemia (1.8, 1.0-3.5). A cancer registry based study of occupational risk for lymphoma, multiple myeloma and leukemia by Brownson and Reif showed that farmers had slightly elevated risk for NHL (1.11) and HD (1.3) and a higher elevated risk for ALL (2.84). Franceschi et al reported that those agricultural workers exposed to herbicides and pesticides had a significantly elevated risk (3.2, 1.6-6.5) for the development of Hodgkin's Disease. A meta analysis of 32 studies of multiple myeloma and farming according to three different methods by Khuder and Mutgi yielded estimated relative risks of 1.23, 1.23 and 1.38 (all three being significant). The authors conclude that such consistent positive findings suggest that there is an association between MM and farming. Exposures commonly experienced by farmers and that might contribute to the occurrence of MM include infectious microorganisms, solvents and pesticides. A similar study on NHL yielded a combined risk of 1.26 (1.2-1.4).

Change In Trends In Alcoholism

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Alcohol consumption is on the increase, both in adults and in children, both in Western and Eastern cultures. The citizens of rural areas are not lagging behind the urban citizens. There is an increase in the incidence and prevalence of alcoholism and related physical and mental disorders among the rural population. The mortality and morbidity are on the increase among the rural population due to various reasons. Even though the ultimate mortality due to alcoholism is unchanged among the urban alcoholics, morbidity is on the increase because of early therapeutic intervention, availability of various methodologies in the treatment of alcoholism. There are many reasons for the increase in consumption of alcohol:

1. Easy availability of alcohol
2. Availability of variety of alcoholic beverages
3. Improved economy
4. Industrialisation
5. Curiosity
6. Learning from other alcoholics
7. Peer group
8. Stressors
9. Negligence of children
10. Other drug abuse
11. Relief from anxiety
12. Relief from unhappiness
13. Failure to identify other coping methods for stressors
14. Genetics

Who Is An Alcohol Dependent?

Any consumer who has three or more of the following symptoms occurring at any time in the same 12 months period is considered as an alcohol dependent.

1. Tolerance: increased amount of alcohol consumption to experience the same desired effects.

2. Withdrawal (vide infra):

3. Desire to consume alcohol:

4. Alcohol obtaining important : An alcoholic discovers various ways to obtain alcohol.

5. Social changes in connection with alcohol use

6. Alcohol related disabilities that do not lead to sobriety

7. Continued use of alcohol despite exacerbation of health problem

8. Avoidance of important social, professional or recreational events because of alcohol use

9. Negligence of duties towards family

Drinking History

1. "C" - Have you ever tried to "cut down" on your drinking?

3. "A" - Have you ever been "annoyed" by any ones comments about your drinking?

3. "G" - Have you ever felt "Guilty" about your drinking?

4. "E" - Have you ever had an "Eye-opener" in the moming?

Two positive answers are suggestive of alcoholism which prompt a detailed workup.

(Daily heavy drinking is more likely to produce physiologic dependence than intermittent / light drinking).

How To Identify An Alcoholic?

1. Tachycardia
2. Puffiness of face
3. Flushing (rhinophyma)
4. Increased perspiration
5. Tremors
6. Easy bruising
7. Nail infection
8. Spider angiomas
9. Dyspepsia
10. Fatigue

11. Unwarranted irritability
12. Frequent absenteeism/dismissals (negligence of duties)
13. Frequent accidents

End Organ Damage

A variety of diseases involving virtually every organ in the body is associated with excessive consumption of alcohol.

I CNS

Wernicke-Korsakoff syndrome - This is due to thiamine deficiency. Acute or sub-acute disorder characterized by severe mental confusion, apathy, drowsiness, ataxia, chronic amnesic stage, prolonged loss of the ability to store new information,disorientation, unresponsiveness, derangement of perception and memory, exhaustion, dehydration, profound lethargy, confabulations, occulomotor impairment(nystagmus, sixth nerve palsy, paralysis or conjugate gaze)

II Liver

A. Fatty Liver (seen in 90% of cases)
B. Alcoholic hepatitis & fibrosis (40%)
C. Cirrohosis (15-30%)
D. Hepatoma

Serious forms are more common in women than in men.

III CVS

a) Coronary artery disease
b) Hypertension
c) Cardio myopathy
d) Various arrythmias
e) Cerbro vascular hemorrhage

Both drinking and withdrawal can raise the blood pressure, but with abstinence blood pressure usually declines.

"Holiday heart" - paroxysmal atrial fibrillation seen in the conjunction with alcohol consumption.

III Reproductive system

Alcohol suppresses testosterone level after as few as 5 days of heavy drinking.Alcohol dependence may cause testicular atrophy, impotence, loss of libido.

Causes of amenorrhoea, anovulation and early menopause. Impairs fertility or spontaneous abortion.

Fetal Alcohol Syndrome

Occurs one in thousand to three thousand live births. Growth retardation, neurologic abnormalities and characteristic facies are seen

IV Gastrointestinal system

1. Oesophageal and hepatic ulcers
2. Carcinoma of tongue throughout esophagus and stomach
3. Frequent diarrohoea - dehydration
4. Pancreatitis, acute, subacute and chronic

V Muscles: Myalgia, acute and chronic

VI Lungs

1. Bronchitis, acute and chronic
2. Carcinoma of the lung

VII Peripheral nerves

Pain, tingling sensation and numbness

VIII Sleeplessness

Psychological Illness

Alcohol withdrawal syndrome

Due to fall in blood alcohol level, severity depends upon daily intake, duration of alcohol consumption, the age of the consumer, physical ad mental health of the individual and history of withdrawals.

Delirium Tremens (D.T.)

This is the most serious of the alcohol withdrawal phenomena with a mortality rate of upto 2-5%. Prediction : it is difficult to predict who will develop D.T. infection, head trauma, poor nutrition, rum fits, previous episodes of D.T. are the contributing factors towards D.T. more than one out of every three patients who suffer fits develop subsequent D.T.

Clinical Features

If D.T. is to occur, it generally does so within 24-72 hours after withdrawal but can appear even after a week of withdrawal. D.T. presents in a dramatic manner and appears to have had an explosive onset. It onsets usually at night. The following clinical features are usually observed in D.T.

Clinical Features Of D.T.

1. Loss of appetite
2. Irritability
3. Tremors
4. Hypervigilance
5. Insomnia
6. Illusions
7. Hallucinations

D.T. Lasts for 10-150 hours.

Management Of D.T.

- I.P. Vs O.P.
- Fluid replacement, atleast 6 lit./ day
- Sedation, chlordiazepoxide, 25-100 mgm, tds/qid
- Thiamine, 100mgm, 1-3 times /day
- High potency vitamin preparation
- Head injury, if present should be managed
- Rule out infection
- Rule out concomitant consumption of other sedatives (especially barbiturate)
- Treat hypoglycemia with glucose
- Monitor serum electrolytes, blood urea, CBC
- Order for LFT, Hbs Ag and ECG
- Half hourly TPR chart
- Decrease stimulation
- Magnesium sulfate 1 gram I.M. 6th hourly for 2 days
- Phenytoin or carbamazpine to be given routinely when there is past history of rum fits

Out Come Of D.T.

- Usually short lived, lasting less than three days
- Terminates in a prolonged sleep
- Rarely prolonged
- Death due to CVS collapse, infection hyperthermia or self injury

The disorder is usually short lived lasting less than three days in the majority of cases. Very rarely recurrent phases may be seen over a longer period of time. D.T. typically terminates in a prolonged sleep after which the person feels fully recovered apart from residual weakness and exhaustion. Rarely, prolonged attack of D.T. may clear to reveal an amnesic syndrome when Wernicke's encephalopathy had been present, unnoticed during the acute stage mortality of patients with epilepsy and alcoholism is considerably higher than that of other group of patients with epilepsy. Death when it occurs is due to cardiovascular collapse, infection, hyperthermia or self injury during the phase of intense restlessness. Any infective process and particularly pneumonia markedly increases the mortality.

Alcoholic Dementia

- An organic syndrome
- Prolonged and heavy alcohol use
- Seen in about 8-9% of alcoholics
- Persistence of dementia for atleast 3 weeks after drinking ceases &, exclusion of all other causes of dementia

Clinical Features

- Deterioration in past intellectual abilities
- Short and long term memory deficits
- Impaired abstract thinking
- Poor judgment
- Impulse control of sufficient magnitude to interfere significantly with work, usual social activities or relationship with others
- No loss of consciousness
- Delusions /hallucinations
- Absence of insight
- Incontinence, impaired mastication and swallowing during end stage

The demented persons of rural areas may not be brought for immediate medical care due to inadequate knowledge of the family members about the illness or due to submitting the sufferers to "faith healers" or other modalities of treatment.

Treatment Of Alcohol Dependence

1. Counseling, involvement of the family members and close associates is beneficial. Educate thoroughly regarding the ill effects of alcohol. Trace the sources of alcoholism and try to modify it. Strengthen the inner personal intimacy. Involve previous alcoholic as a good role model.
2. Religious invoivement, with the involvement of religious leaders and opinion leaders.
3. Meditation
4. Yoga
5. Regular follow-up indefinitely
6. Treat anxiety if present
7. Treat depression if present
8. Pharmaco therapy, disulfiram, Naltrexone
9. Treat associated problems
10. Continuous motivation many times yields favourable results

Care Of The Surgical Wound In An Industrial Set Up

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WOUND HEALING is the pride of surgeon. Healing means replacement of destroyed tissues by living tissues. Eventhough the principle of wound healing is constant, this lecture would highlight the need to concentrate on THE WOUND.

Wounds may be caused by:

1. Trauma
2. Physical, chemical and microbial agents
3. Ischemia

In the context of wound healing TWO terms should be understood

1. Regeneration - Which means replacement of lost tissue by tissue similar in type. This is not "reconstitution" which means co-ordinated regeneration of several types of lost tissues.

1. Repair - Replacement of lost tissue by granulation tissue, followed by fibrosis and scar tissue formation.

Types Of Wounds

1. Incised
2. Lacerated
3. Penetrating
3. Crushed

Mechanisms Involved In Wound Healing

1. Inflammation
2. Wound contracture
3. Epithelialisation
4. Granulation tissue formation

Causes Of Wound Contraction

1. Removal of fluid
2. Contraction of collagen
3. Contraction of granulation tissue

Factors Inhibiting Wound Contraction

1. Corticosteroid administration
2. Burns - delays wound contraction
3. Immediate skin grafting prevents wound contraction
4. Irradiation - delays wound healing
5. Cytotoxic agents like vinblastine and trocinate, colchicine inhibit/delay wound contraction

Factors That Influence The Tensile Strength Of The Wound

1. Direction of the wound
2. Pull of underlying muscle
3. Previous wound
4. Abdominal binder

Factors Affecting Granulation Tissue Formation

1. Cortisone administration
2. Scurvy
3. Protein starvation

Complications Of Wound Healing

1. Implantation cysts
2. Painful Scars
3. Cicatrization and deformities
4. Keloid formation
5. Neoplasia

Factors Influencing Wound Healing

General factors	**Local factors**
Age	Position of skin wound
Nutrition	Blood supply
Hormones	Tension
Anaemia	Infection
Uraemia	Movement
Jaundice	Exposure to Ionizing Radiation
Diabetes Mellitus	Foreign bodies
Blood dyscrasias	Adhesion to bony surface
Malignancy	Necrosis
Cytotoxic drugs	Lymph drainage
	Ultra Violet rays/light
	Faulty technique of wound closure

Principles Of Wound Management

1. Classification of wound
2. Convert dirty wound to a clean wound
3. Role of thorough debridement
4. Role of delayed primary suturing
5. Role of dressings of wound
6. Role of Hyperbaric Oxygen therapy
4. Role of drainage of wounds

Conclusion

Providence triumphs over vallor.
Be gentle to tissues.

Veterinary Zoonosis

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Right from earlier times it had become apparent that man shared infections in common with animal species he was associated with Hippocrates of (5th Century B.C.) emphasized the role of environment in preservation of human health. As early as 116 B.C. Marcus Terrentius Verro suggested that marshy lands maintained minute creatures which caused serious diseases in human habitation. It is quite interesting that most of the earlier suggestions of relationships between human health and animals were part of folk lore or religious practice. Such an awareness resulted in early man identifying specific disease in sentinel animal species and take appropriate measures to keep away from them or sacrifice such animals to avoid epidemics. Now we know that these earlier episodes cannot be ignored as blind followings and such practices were to keep the human species away from diseases communicable from animals which were dwelling close to him. Such diseases are designated as "Zoonotic" and the science dealing with it as "Zoonosis".

The World Health Organization defines Zoonoses as "Those diseases and infections which are naturally transmitted between vertebrate animals and man". The probability of disease transmission from animals to human is influenced by several factors, such as:

1. Socio-economic
2. Ecological
3. Contact with companion animals
4. Stocking density of animals and disease mediators
5. Human behaviour and his food habits.

Based on maintenance cycle, of zoonoses in nature, Schwabe (1984) has identified four groups:

1. Direct Zoonoses: which can spread by a single vertebrate species either by direct contact or through a mechanical vector.
2. Cyclo Zoonoses: where the infection is maintained by more than one vertebrate species.
3. Meta Zoonoses: in which the cycle involves both vertebrate and invertebrate hosts.
4. Sapro Zoonoses: which depend on in animate development sites as well as vertebrate hosts.

Any disease that comes within the ambit of zoonoses has five components.

1. The agent: A parasite adapted to a lower vertebrate host with a potential to infect human is a zoonotic disease in real sense. On the contrary if the agent has normally a broad host spectrum including man, it cannot be termed as a zoonotic.

2. Reservoir host: This component is usually a lower vertebrate in which the agent naturally occurs without overt manifestations of the disease.

Generally a number of related species of vertebrates can serve as maintenance hosts to a given parasite. Yet it is seen only a few species of animals are preferred in which the intensity of infection of a particular agent is very high rendering them as the potential disseminators.

3. Intermediate host and vector: This component is not mandatory for all zoonotic diseases. It is essential for certain agents wherein a specific developmental stage of the agent takes place. This aspect therefore plays a very significant role for disease communication to man.

4. Potential host: Invariably, this is man. Man is not a natural host in most zoonotic diseases. But is susceptible. Audy (1965) prefers to call human as "Species at risk"as he exposes himself to the agent by intruding into the ecological niche of the maintenance host. This "risk" is brought about by the activities of man himself such as religious considerations; social practices;food habits; socio-economic status; recreational and professional hazards.

5. Environment: Zoonoses are associated with specific reservoirs and often with specific vectors. The habitat of these, in turn, are associated with specific type of localities which fulfill the requirements of these two components. When two types of environmental requirements overlap , thedisease agent circulates between the two more or less restricted localities termed as "nidus". When man enters the nidus of a disease and disturbs it, he is likely to acquire the disease.

Man disturbs the nidus by activities such as deforestation, cultivation, animal husbandry, habitaion and settlement. The general consequences of these activities are:

1. Simplification of existing ecosystem
2. Creation of edge effect

1. Simplification of ecosystem: Human activities lead to destruction of vegetation thereby simplifying the original ecosystem hitherto a rich and stable system that evolved over a long period of time. The consequences of such simplification are:

- Introduction of newer species to the original ecosystem.
- Uneven distribution of the existing species.
- Fluctuation in population of animals and plants due to human utilization

2. Edge effect: When two types of contrasting ecosystems occur side by side an edge effect is experience. This immensely influences the natural nidus of infection because it frequently encourages the exchange of the agents between maintenance hosts and the susceptible hosts which would otherwise hardly ever takeplace.

The edge effect gives an opportunity for wild vertebrates to mix with domestic vertebrates helping free exchange of agents as well. When these animals enter human habitation, pathogen also have an access to man.

The edge effect will allow some species to take advantage of biocenose for one purpose and the other for another purpose.

In this context it is pertinent to point out that arthropods play a major role as mediators of disease and a long list is available now which have been identified as exclusively transmitted by them. All these diseases are placed under the group **Meta Zoonoses**. The transmission of pathogens by vectors is profoundly influenced by a number of parameters like vector density; population density of the host; environment; spectrum of pathogen susceptibility of the vector; geographic distribution of specific species and subspecies of the vector. This knowledge will immensely help in designing strategies for their control.

The basic principles of Zoonoses control and prevention are focused upon breaking the chain of transmission at its epidemiologiclly weakest link. They involve:

1. Reservoir neutralization
2. Reducing contact potential to the host
3. Increasing host resistance.

Most of the Zoonoses had their origins in the feral species without regard to the presence or absence of man. To become a Zoonoses, the agent had to gain access to humans by integrated cycles of transmission such as :

- Sylvatic-human cycle
- Sylvatic-domestic cycle
- Sylvatic-domestic-human cycle

From this it is obvious that the Zoonotic agent reaches man directly from a sylvatic cycle or indirectly through a domestic species. Once it reaches man it is invariably a dead-end.

Reservoir neutralization can be achieved by test and disposal, mass therapy or by environmental manipulation where in the vicinity around the reservoir as decontaminated.

The contact potential can be reduced by isolation, quarantining, population reduction of mediators. Stress reduction, chemotherapy or immunization are some of the other options available for increasing host resistance.

To achieve these goals a proper understanding of the disease, their cycles in nature, modes of their transmission, appropriate steps of containing them are essential.

Occupational Health Problems among Poultry Personnel

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Poultry farming which were a backyard and a subsidiary occupation has now become a highly commercialized agri business. It has taken an industrial proposition world over. Currently, India stands fifth country in egg production and 2oth in broiler production, contributing a sum of Rs. 65 million to the GDP of our country. This profession provides direct employment for more than 1.0 Million and indirect employment to more than 1-3 million people in the country. The working personnel of poultry directly or indirectly exposed too many health hazards in this industry and the magnitude has not been assessed properly. Therefore an attempt has been made to enlist health-related problems among poultry workers in this paper. The poultry personnel include workers supervisors, managers, veterinarians and laboratory workers.

The occupational health problems of poultry workers could be classified as those problems arising from physical, chemical and biological hazards.

Physical Hazards

These include external injuries arising from fencing barbed wires, building materials and from machines used in day to day work and electric shock and thermal burns etc. Feed mill workers often suffer from fatal accidents and electric shocks besides inhalation of air borne physical dust particles, dried fecal matter, feed particles, fragments of skin and feathers from the dust of varying particle sizes. Dobie 1964 has reported the amount of air borne dust in poultry house. According to him, the 24-hr. dust collected in 100 c ft. is 54 grams in cage system and 4 times greater in deep litter. Excessive dust level damages the lung macrophage system.

Table: 1 Percentage of suspended particulate matter and itssize in poultry sheds

% age distribution	Size of the dust particle
100	0.5 µm
3.2	1.0 µm
2.5	2.0 µm
0.4	5.0 µm
0.07	10.0 µm

Allergic alveolitis

Allergic alveolitis is also called hypersensitive pneumonitis, Parakeet dander, pneumoconiosis and pigeon lung disease. It occurs in people who are hypersensitive to feathers, feather dust and fecal material. Signs occur within two years but often takes as long as 10-20 year with continuous exposure.

It may occur in acute or chronic form. The acute form occurs within 4-8 hours of inhalation of high level of feathers, feather dust and fecal matter. Cough, dyspnoea, chills and fever occur. If exposure is topped at this time, no treatment is necessary and signs will disappear. The sub-acute form results from long term exposure. A dry cough and progressive breathing difficulty occur. This form may also be reversed if continuous exposure is stopped. If continued, it leads to a non-reversible chronic form of alveolitis with severe dyspnoea, dry cough and weight loss.

Allergic alveolitis decreases lung capacity and causes diffusion of air through the alveoli of the lungs.

A high degree of biosecurity, including cleaning of poultry houses, cages, avoidance of overcrowding, providing good ventilation or use of air purification system helps in containment of this problem.

The other pollutants arising from poultry house includes a variety of dusts borne microorganisms such as staphylococcal and streptococcal organisms derived mainly from resident flora of skin epithelium. Aerobic spore forming and colliform bacteria arise from litter and feed dust. Henry and Hansen 1964 obtained 20,000 to 80, 00,000 E. coli organisms in a gram of dust from the bird level. Aspergillus fungal spores that arise from litter material as well as grain material often cause respiratory mycosis in poultry attendants.

Table - 2: The concentration of air borne bacteria in different poultry housing systems

Housing System	Conc. of coliform bacteria/liter of air
Deep litter system	132 -17,000
Cage system	1000 -10,000

Source: Muller and Weiser 1987.

Noxious gases

In modem environmentally controlled (EC) poultry sheds there is always a problem of noxious gases. The main gases are ammonia, carbon-di-oxide, carbon monoxide, methane and hydrogen sulfide. All these gases originate from wet litter problem.

Ammonia content of above 20 PPM is known to cause local irritation in the mucous membranes of the respiratory tract and sinuses, resulting in inflammation, air saculitis and respiratory distress. This in turn leads to impair feed conversion efficiency of the birds resulting in poor growth. Ammonia content of over 50 PPM causes severe kerato conjunctivitis, watery eyes and blindness.

During wet conditions when the moisture contents of the litter is over 30%, Ammonia content is often shot up by 10-15%. This ammonia at higher levels induces pungent sensation and eye irritation to the personnel working in such houses. The minimum requirement for air composition should be as follows:

Oxygen	over	16%
Carbon dioxide	under	0.3%
Carbon monoxide	under	0.004%
Ammonia	under	0.002%
Hydrogen sulfide	under	0.0005%

These gases are interrelated because of the bird's physiological responds as oxygen content decreases and carbon dioxide increases during metabolic processes. Similarly microorganisms leading to ammonia and hydrogen sulfide accumulation in the air break down bird's droppings.

Chemical hazards

There are several chemical agents, which are used in poultry farming. These include use of many nutrients in formulation of balanced feed. For e.g. amino acid especially methionine, lysine etc., use of disinfectants and their residues in meat and meat products and egg. Feed additives such as growth promoting hormones antibiotics etc. Residues of antibiotics in poultry meat may occur if withdrawing times are not adhered to. Allergic reaction in many persons may occur to penicillin, sulfonamides, neomycin, Tylosin, tiamutin and this reaction is not dose dependent. Extremely small doses are only required to elicit reaction.

There are two types of reaction in human health, dermal allergies can occur while mixing of these additives in feed by bear hands and secondly transfer of antibiotic resistance from bird to humans through residual effect in meat, meat products and eggs.

Table 3: Environmental impact of some antibacterial drugs (adopted from Anonymous, 1976)

Drug	Oral doses excreted % age	Fate in the environment		Drug resistant Non-enteric bacteria
		Half life	Accumulation in days	
Chlortetracycline	40-75	>20	High	+
Oxytetracycline	40-75	>20	High	+
Penicillin	?	<7	Low	+
Sulfonamide	upto 7C	>20	Moderate	+
Streptomycin	upto 100	7	Moderate	+
Neomycin	95	?	Low	+
Bacitracin	95	4-10	Low	+
Tylosin	30-76	?	?	0
Viginamycin	?	7	Low	0/+
Lincomycin	100	20	Low	+
Erythromycin	High	?	Moderate	+
Monensin	35-75	10-70	Low	0/+
Avoparacin	High	?	Low	?

Bio Hazards

Intensive poultry farming have formidable potential for waster production and its pollution. Bacterial, viral and parasitical pathogens can occur with fecal wastes of birds. The bacterial pathogens that are of particular concem in poultry waste are salmonella, E. Coli and chlamydia.

The survival times of salmonella spp. in the farm animal waste has been estimated at 200-300, 90-200 and 5-25 days in liquid manure of cattle, pigs and poultry respectively. The salmonella organisms could be isolated from soils for 8 months after application of contaminated piggery and poultry waste.

Spread of enteric bacteria in the environment especially E.coli is highly successful bacteria excreted through poultry that and pass through fecal matter. Pollution occurs in pastures, streams and rivers. From litter/fecal contamination and from which the organisms may infect and colonize in other animals and humans. Farmers, abattoir workers, butchers will get contact with enteric bacteria especially antibiotic resistant E.coli and enterobacteriae especially Salmonella.

A variety of disease causing agents may affect the farmers through zoonoses (Diseases transmissible from poultry to man).

Young children, elderly adults and immuno-compromised individuals are at great risk of being infected by zoonotic diseases. Immune-compromised individuals include those infected with the Human immuno-deficiency virus (HIV), patients taking immunosuppressive drugs, cancer patients and the unborn fetus.

Although the list of zoonotic diseases involving birds is somewhat extensive, the following diseases are of reasonable significance.

Chlamydiosis (Psittacosis or parrot fever)
Salmonellosis
Campylobacteriosis
Newcastle disease
Mycobacteriosis
Influenza
Giardia and
Cryptosporidiosis.

Chlamydiosis

Psittacosis is a common disease of wild birds throughout the world, caused by Chlamydia psittaci. The birds are often exposed to infection and the organism settles down in spleen without causing any effects. These birds pass Chlamydia intermittently in the feces and transmit to their young ones at the next breeding season. Such latent infection can be activated by stress. Chlamydia is a disease of Psittacine birds (eg.Parrots, Cockatoos, Budgerigars). A wide variety of other species can be affected (finchers, sparrows, pigeons and waterfowls) and these spread infection to commercial flocks. Duck farms established nearer to waterfowl migrating areas can infect ducks and farm employees and workers in poultry processing plants where ducks are killed.

Chlamydia psittaci can survive in poultry litter for 2-8 months and litter material is the potent source of contamination and infection occurs by inhalation. Mites can also harbor Chlamydia for three or more months.

In agricultural enterprises those predominantly at risk are poultry farmers and their families, Veterinarians and employees in poultry processing plants and diagnostic laboratories. Hazardous aerosols are created from dried fecal material, liberated down and feathers during killing, breeding, de-feathering and eviscerating process of poultry. Similarly aerosols arise during necropsy of dead birds and veterinarians will be at risk.

Disease in humans occurs as an acute generalized infection of variable severity, after an incubation period of 4-15 days resembling mild influenza with headaches and myalgia, before fever develops and symptoms become more acute. Person to person spread is possible but rare. Fever, headache, muscle pain, photophobia are common findings. Control of dust, high degree of sanitation, preventing contact between free living and domesticated birds, management induced stress in the birds must be minimized. Avoiding overcrowding, stress during transportation between farms and abattoirs and

Depriving them of food and water can increase fecal excretion of Chlamydia and precipitate clinical disease. Infected flocks should be quarantined. High doses of tetracycline's helps in suppressing the infection but not always eliminate. Poultry industry employees must remain aware that Chlamydia is shed intermittently in the faces of normal birds so that the infection can be transmitted without necessarily having contact with obviously diseased birds. Regular disinfection of poultry houses, abattoirs and prevention of aerosol infection are important in reducing human exposure.

Salmonellosis (Food poisoning, enteric paratyphoid)

Poultry products are important sources for humans since the intestine may rupture when the pluck is removed from the carcass during processing, liberating gut contents into the thoracic and abdominal cavities. Stuffing introduced into interior becomes contaminated with Salmonella organisms.

The farming community has an important responsibility to limit the incidence of salmonellosis. In the first place, birds should be raised under good management and nutritional conditions so as to control the occurrence of infection diseases so that birds sent to market are in good health.

Listeria monocytogenes

It is a ubiquitous bacterium found in the intestinal tract of human and animals including variety of vertebrates, and in soil and water in which it can survive for months to years (Mitscherlich and Martin, 1984). Occupational risk of acquiring listeriosis is greater among persons handling poultry.

Listeriosis has similar manifestations in humans and animals, with meningioencephalitis or abortion, prenatal mortality of off sprint and septicemia as prominent syndromes.

Mode of Spread: Contaminated litter
Manure to grow vegetables
Soil contamination
Eating raw vegetables
Listeriosis

Compylobacteriosis

This disease is caused by Compylobacter jejuni, a Gram -ve, non-spore forming, motile rod. This organism has been incriminated as a cause of diarrhea, often exclusive in onset, accompanied by acute abdominal pain. It is a common bacteria of gut of birds; claims have been made that human infection is usully acquired from dressed poultry.

Avian Tuberculosis: (Mycobacteriosis)

Avian tuberculosis is caused by M. avium; M.intracellave and M.genovense, M.tuberculosis and M.bovis have been isolated in birds. These organisms occur throughout the world in the waterfowls, psittasins, pesserines, columbiformis and raptores.

Humans are more commonly infected with M.tuberculosis and M.bovis. Immunocompromised people, (ex.HIV infected) those on chemotherapy, the elderly and children are at risk.

Ingestion and inhalation of aerosolized infectious organisms from faces transmit avian tuberculosis.

In adult humans, tuberculosis frequently affects lungs, producing respiratory signs. In young children the cervical lymph nodes are often involved and in HIV patients often have disseminated form. People who are infected with human tuberculosis should not own birds, since people may serve as source of infection to their pet birds.

Newcastle Disease (ND)

ND is a viral disease of domestic and wild birds predominantly transmitted by inhalation and with a wide spectrum of pathogenicity. Spread through ingestion of infective material is also possible. Considering the wide spread nature of ND in poultry, human infections are relatively less. Those at risk are poultry farmers and Veterinarians and laboratory workers. Human infection with virulent NDV develops as conjunctivitis, usually with enlargement of precrural lymph nodes. Fever of variable degrees with headache and lethargy develop in a minority of cases. Infection runs a short course resolving without residual complications with in 2-3 weeks.

Avian Influenza

The so called bird flu a synonym of avian influenza or Fowl plague an infectious syndrome caused by influenza type A virus belonging to family of Orthomyxoviridae. It is a pleomorphic RNA virus having three antigenically distinct types, A, B, and C types. Type A is causing avian influenza, whereas B and C are typically found in humans. Type A can also jump into other spp. Such as swine, horse, mink, seals, whales and human beings.

A strain was previously known to infect only birds was isolated in Hongkong from a specimen collected from a 3 year old child who died in May 1997, of respiratory failure. The virus was identified as influenza Type-A (H5N1).

The influenza A- (H5N1) virus is known to infect ducks, chickens and other birds but had not previously been isolated from humans.

Between late November and 30th 1997, a total of 13 confirmed and 6 suspected H5N1 influenza cases have been identified. The age group of the confirmed cases ranged from 1 to 54 years. However seven of 13 confirmed cases are 5 years of age or younger.

Blood samples collected from family members of cases, nursing staff and other contacts, antibody to influenza A (H5N1) virus was found in nine blood samples out of 502 tested in May 1997 in Honkong. The antibody to virus was detected mainly among poultry workers and people directly exposed to virus. As a precautionary measure, the Honkong authorities have destroyed 1.3 million chickens between 30-31 Dec.1997, in order to eliminate the potential risk of transmission of the infection from poultry.

Ringworm

Ringworm is a common skin infection of animals and birds. Only Trichophyton verrucosum and T.mentagrophytis cause ringworm infection in humans. The condition is manifested as acute inflammatory reaction spreading lesion usually on the face of persons of all ages who are handling contaminated poultry.

Ectoparasites

Many ectoparasites are capable of affecting humans, either by direct contact or from environment. Stick fast fleas (Echidnophaga gallinaceae) of poultry attach around waist in the hair and around neck and legs causing considerable irritation and hypersensitivity.

Ornithonyssus spp.redmite of poultry also cause nuisance in human beings.

Conclusion:

In poultry enterprise those, predominantly at risk are poultry farmers and their families, veterinarians, employees in the poultry processing plants and diagnostic laboratories. The dust and microbiological agents are always found to be there in poultry houses and both can therefore affect the health of man and birds. The respiratory system is mainly affected. Chemical and mechanical irritations and allergic reactions can develop. The nuisance of files and odor can cause unpleasant situation reduced appetite leading to nausea and vomiting. Ammonia is the main cause of irritation to the mucus membrane and inhibits cytochrome oxidase depressing cell metobolism and affecting the central nervous functions. The egg and meat products carrying residues of antibiotics may cause development of resistant strains of bacteria. Therefore careful selection and application of drugs for growth promotion and therapy is necessary. Use of biotechnological methods to control biohazards such as Salmonella, E.coli, and Campylobacter etc. has to be considered for future poultry farming.

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Health Hazards Among Small Laboratory Animal Workers

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Use of laboratory animals in biomedical research, teaching, demonstration and drug testing has increased tremendously and thereby all the research workers, laboratory workers, technicians, animal handlers are exposed to various health hazards in animal house environment. This paper attempts to discuss all aspects of health safety in the animal facility and laboratory.

Physical Hazards (Direct Environmental Hazards)

First and foremost hazards directly exposed to will be the work environment where the persons have to work in the presence of animals. Whatever is the type of air-conditioning system to maintain the temperature and proper adoption of air changes, there is some amount of effect on workers due to exposure to animals as well as their excreta which creates enough odour, unless the bedding of the animals are changed frequently along with excreta. Otherwise, there is bound to be increase in the humidity as well as ammonia concentration which will affect the workers when it exceeds the permissible limit of 40 PPM. The effect of this will be seen in persons as symptoms of irritation of eye and nasal mucosa. This could be reduced by frequent cleaning and health sanitation procedures.

In case of emergency washing of the eyes with cold water and application of eye drops will help in controlling eye irritation. So also usage of filter masks could reduce nasal irritation.

Injuries From Animals

In working with animals, scientific workers and technicians come across bites and scratches from rats, mice, rabbits and guinea pigs which can be treated as a normal wound and precaution could be taken by giving a shot of anti tetanus vaccine. However in case of bites from dogs and monkeys it should be viewed more seriously. Monkey and dog bites often cause serious wounds which needs to be stitched up under sterile conditions and needs proper care which includes anti tetanus and anti rabies vaccine.

It is advisable to have all the staff immunised with anti rabies and hepatitis B vaccine every year. When the monkeys are caught from endemic areas of herpes B virus and Kyasanoor Forest Diseases special care has to be taken to vaccinate persons against those diseases also.

With reference to maintenance of dogs, one should take care about the effect of continuous barking on the workers psychologically. There is also a fear complex associated with anxiety among workers handling the dogs. This can be avoided by adopting a work regimen of frequently rotating the workers between different facilities of the animal house.

General Physical Hazards

In an animal colony doing experimentation there is always some minor technical operations and surgical operations. In such situations, handling of needles for injections and surgical scalpels may cause accidental injuries. If the same needle and scalpel are used for animals such wounds should be treated separately. History of such animals and their symptoms need to be obtained. It is therefore better that protective gloves are used in all situations.

During some experiments with animals, aerosols are used for disinfecting the animal cages and animal rooms. The concentration of the aerosols used like formalin should be carefully monitored. A wash with mild disinfectant aerosol is mandatory. A period of time is to be allowed after aerosol disinfection before allowing the personnel to enter the rooms in such situations.

Other aerosols are the animal dust, fur and hair , which can cause irritation to the eye and nasal mucosa from the animals which may later on develop into allergic reactions. In such cases the personnel should be skin tested to allergies against each of the species handled prior to commencing the work and wherever possible avoid or minimse contact by use of protective clothing. Even the odour of urine and faeces may be sometimes allergic to the workers, which can be avoided by using protective masks. Smoking in the vicinity of animal rooms causes the inhalation of allergic dust, fur, hair and other odours. This should be avoided.

Biological Hazards

All animals must be regarded as potential sources of naturally transmitting infections, which are called zoonotic diseases. Though this risk varies widely with the class and species of animals involved, an animal which is more closely related with human has greater likelihood of transferring the disease to man. It is for this special reason that special precaution has long been advocated for handling non-human primates.

While most of the infectious agents show a considerable degree of species specificity, they may also vary from time to time widely in their virulence and their capacity to break through species barrier. These infections, which are not commonly considered hazardous to human beings, may sporadically affect susceptible persons when come in contact with animals. Numerous pathogenic microorganisms such as those responsible for tuberculosis, brucellosis, rabies, tetanus may be transmissible to man. Infections such as ringworm are particularly wide spread often in a subclincal state. The life cycle of a causative organism implicated in a number of indirect infections transmittable to man through one or more intermediate hosts are toxoplasmosis, taeniasis, tularaemia and vesicular stomatitis. In case of cold-blooded animals like tortoises with salmonella infections can cause human health hazard.

The transmission of infections from animal to man can generally be avoided through proper veterinary care and adherence to careful experimental procedures. Quarantining of animals before they are introduced into the colony and thorough examination of animals including the microbiological, parasitological and viral monitoring would go a long way in ensuring the safety of workers working with animals.

It is important to ensure that animal technicians and workers are healthy and have normal resistance to infection. Particular attention should be given to allergic reaction of the worker to animal dust, fur, waste and excreta.

Bio Hazard Identification And Hazard Protection

Diseases can be transmitted from man to animals and animals to man. The former could be avoided by carefully monitoring the animal workers' health. If the worker is ill, the medical officer concerned should decide whether or not the person should continue to work with animals. Similarly the responsible veterinarian or supervisor must decide whether or not to continue the utilisation of worker handling the animals.

Personnel cleanliness is an important barrier to infection. Washing of hands after handling animals will reduce the risk of disease spreading and self infection. To facilitate this each animal room should be provided with small hand sink, soap and paper towels. In any event, the working staff should be continuously reminded of this simple but significant precaution.

Smoking, eating and drinking should not be allowed in animal holding rooms and other areas in which pathogenic microorganisms are being handled. No person with open wounds or an eczematous condition should be allowed to work where he is likely to come in contact with pathogenic microorganism unless he has sufficient protective clothing and gloves.

Laboratory clothing worn in risk areas should be autoclaved before they are washed. Shoes should have disposable covers in barrier and high risk areas.

If highly infective animals and agents are to be used, the experimental animals should be isolated. Ventilated cabinets or cages should be sterilised (Horsfal and Biolaminar flow units) and all exhausted air should be burnt out or filtered.s

When animals are injected with pathogenic material, the animal worker should wear protective gloves. Gloves should be worn while feeding, watering and removing the infected animals.

Necroscopy and autopsy of animals infected with contagious organisms should be carried out in ventilated safety cabinet. Necroscopy material for disposal should be sealed in plastic bags which are sealed, properly labeled and incinerated.

Chemical Hazards

Injuries from chemicals can be avoided by treating all chemicals with care and by knowing their properties and adhering to the accepted safety procedures for handling that type of substance. In assessing a chemical, the following points should be noted:

a. Name
b. Physical state (solid, liquid, gas)
c. Toxicity (acute or chronic), by injection, inhalation and absorption
d. Maximum permissible concentration
e. Vapour density (concentrations at ceiling and flooring)
f. Miscibility with water (antidote)
g. Compatibility with other chemicals
h. Inflammability (whether high or low) and storage condition requirements

These chemicals should not be stored with animal feed. Volatile liquids used as anaesthetics or for euthanasia and other toxic and volatile materials should be stored in separate cool, well ventilated and at specially designated no smoking areas and away from fire hazard zones.

Animal house wastes which cannot be rapidly disposed off should be stored in a cold storage area provided for that purpose. Such areas must be vermin free, easily cleaned and disinfected as well as being physically separated from the other storage facilities. The waste storage areas should be located so that the wastes are not carried through other rooms of the facility.

National guidelines as well as local provincial laws with regard to waste disposal should be followed.

An incinerator with controlled air system is probably the most efficient with very low stack emission.

Radiation And Ultraviolet

Radioactive wastes present special hazards to the workers working with these material. They should know the properties of each and should be familiar with appropriate safe handling techniques and other regularities. The workers and technicians working with radio active materials should be specially trained in the radiation safety procedures.

Isotope treated animals may pass radioactive material in their excrement and also exhale radioactive vapours. Personnel should take special precaution to avoid animal scratches or bites. Complete records should be kept throughout the final disposition of these animals.

The radiation areas should be separated from other animal housing and work areas. Isotope rooms should be covered with non porous material which can be replaced if contaminated where extreme precaution are needed for disposal. Water proof paper with gummed backing may be applied to walls, floors, benche tops and discarded after use with due precautions.

The eye and skin are critical areas for ultra violet exposures. The eye, in particular, can be seriously injured if U.V. lights are accidentally switched on. The workers can use wrap around safety glasses. The maximum intensities which could be for sensitive person ranges from 0.1 - 0.5 milli watt per sft.

Precautions To Be Taken By Animal Workers

1. Use rubber gloves while handling animals, animal wastes and animal tissues.

2. Require routine use of lab. coats and overalls issued specifically for animal quarters.

3. Carry out prolonged procedures for animals under a ventilating hood.

4. Keep oral and injectable anti histamines for urticaria and rhinoconjunctivitis, adrenergic compounds such as ephedrin for asthma.

5. Work involving exposure to hazardous microorganism may require prior immunisation of staff if a vaccine is available. Serological testing and banking of a reference serum sample from all personnel working in the animal facility is an advisable procedure to follow.

6. Caution should be exercised in assigning women of child bearing status to animal care duties that might expose them to potential or known teratogenic agents.

Hazards Of Laboratory Animal Workers:

Examples of cross infection in laboratory animals

1.

Rat ↔ Mice ↔ Man:	Salmonellosis and respiratory diseases.
Dogs ↔ Rodents ↔ Man	Respiratory diseases, cestodes.
Cats ↔ Pigs ↔ Man	Respiratory infections, skin infection and tetanus.
Guinea pigs ↔ cats ↔ Man	Pseudotuberculosis.
Dogs ↔ Monkeys ↔ Man	Ringworm (M. camis)

2. Routes Of Infection:

1. Bite: Direct inoculation often deep
2. Scratch: Often introduces dirt into wound.
3. Existing wounds: Accidental inoculation by contact
4. Aerosol by infected saliva or other body fluids via lungs, eyes etc.,
5. Mammal infection via mouth from contaminated fingers
6. Accidents involving skin punctures from soiled needles etc.
7. Anthropod vector (ectoparasites or substitute hosts)
8. Inhalation of contaminated dust or dried fecal material

3. Mice And Rats:
Diseases transmissible to man from rats and mice:

Murine pneumonitis virus	Respiratory pyrexia
Lymphocytic choreomeningitis virus	Respiratory pyrexia
Pastuerella multoceda (septica)	Respiratory pyrexia
Salmonella Typhimirium	Enteritis
Trychophyton metagraphitis	Ring worm

Streptobacillus monilliformis	Arthritis
Leptospira icterohaemorrhagica	Leptospirosis, infectious jaundice
Spirillum minus	Rat bite fever

4. Dogs
Diseases transmittable from dogs to human:

Toxacara canis	Canine roundworm
Ancylostoma canninum	canine hookworm
Echinococcus granulosus	Tapeworm (leads to hydatid cyst)
Toxiplama Gondii	Ring worm
Microsporum canis	Ringworm
Leptospira canicola	Leptospirosis, infectious jundice

5. Diseases Tranmitted From Monkeys To Man

Ectoparasites	mites	Scrub typhus, scabies, pulmonary ascariasis
Endoparasites	flukes	Schistosoma sp.
	Tapeworms	
	Roundworms	Hookworms and filariae

Protozoal diseases

1. Intestinal	Entamoeba (amoebic dysentry)
2. Blood borne	Trypanasomes, sporozoa(malaria), toxoplasma

Bacterial diseases

1. Enteric	Shigella species (bacillary dysentry)
2. Blood borne	Spirochaetes
3. Respiratory	Tuberculosis

Viruses

1. Normally occurring non-pathogenic types in apes and monkeys transmitted to human become fatal. Eg: Yellow fever
   Herpes B. simiae
   Lassa fever

5. Safety Philosophy

a. Aim for good accommodation and husbandry
b. Beware of potential hazards
c. Report all incidents
d. Prohibitions are applied rigidly irrespective of the status of the person
e. Firm and discreet policing of general procedures
f. Regular review of procedures
g. Designate a safety officer with full authority to act
h. In-house training at appropriate levels is a must

Causation of Work Environment And Chemically Induced Cardiac Diseases

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Cardiovascular function is regulated to preserve two vital functions, tissue oxygenation and normal body temperature. For example, during muscular exercise, the oxygen supply to the working muscles must be increased, and concurrently the increased heat generated must be dissipated. Humans are often subjected to environmental factors that stress cardiovascular regulation severely. Exposure to high altitude induces atmospheric hypoxia, which reduces muscular working capacity in spite of major adaptation to preserve tissue oxygenation. In hot environments, temperature regulation must compete with increased demand for oxygen during exercise and here again working capacity is reduced. Regrettably our environment is frequently contaminated with noxious substances one of the most lethal of which is carbon monoxide. To the patient the cardiovascular disease adaptation to such environmental stresses as heat, cold or the high altitude induced hypoxia becomes an even greater challenge.

Ascent to high altitude increases myocardial oxygen demand, primarily through increased Heart Rate (HR). Such increased demand must be met by increase in oxygen supply. In general, this is accomplished by increasing coronary blood flow. Within a few days HR will decrease and arterial oxygen content will be restored by haemoconcentration. In addition, there is a shift of the oxygen dissociation curve to the right.

In patients with stable coronary heart disease and reasonably good exercise tolerance at sea level, exposure to high altitude is not likely to precipitate a coronary event. The heart rate for a given level of exercise is higher but there is no increase in ST-T changes.

Acute ascent up to 10,000 feet (3000 meters) does not result an increase pulmonary artery pressure. Residence at the altitude will result in pulmonary hypertension. The pulmonary artery pressure (PAP) is usually twice that at sea level, the mean PAP ranges from 11-45 mm Hg. and during exercise may exceed 60 mm Hg. The pulmonary hypertension of high altitude is generally benign, non-progressive and reversible with descent to lower altitude.

Occasionally patients ascending to high altitude develop acute high altitude pulmonary edema (HAPE). The incidence is between 1 and 10 per 10,000 persons ascending rapidly to high altitudes above 8,000 feet (2,400 meters). Symptoms are usually seen between the second and seventh day at such high altitudes. The patient has undue shortness of breath, cyanosis, tachycardia, crepitations, fatigue and non-productive cough. This is a form of non-cardiogenic pulmonary edema and recovery is prompt on descent to lower altitude. The pathogenesis is uncertain. It is either due to increased permeability of the lung vessels or increased pressure within the pulmonary vessels which force fluid into the lungs. The consensus is that HAPE is part of the spectrum of acute mountain sickness, with relative hypoventilation and abnormal fluid retention as underlying factors.

Heat Stress

Humans adjust to heat stress mainly by altering the vasomotor state of the skin to regulate heat exchange with the environment. Sweating and shivering further modifies thermal balance.

Patients with mild CHF when exposed to heat stress can have acute cardiovascular collapse. Heat injury in saunas can occur rapidly with no prodromal warning. The risk is higher in-patients who are hypertensive or who are prone to coronary insufficiency.

Cold stress

Exercise in cold environment is stressful to patients with effort angina. The cold environment probably causes a reflex sympathetic stimulation with a resultant increase in systolic blood pressure and a modest increase in heart rate. This elevation of the rate of pressure product increases myocardial oxygen demand, which is normally met by endothelial dependent coronary vasodilatation. In-patients with coronary artery disease, there is a paradoxical decrease in coronary blood flow because the loss of endothelial function results in unopposed constrictive influence of sympathetic stimulation.

Exposure to noxious substances

Carbon monoxide exposure is common, in work places close to motor vehicle exhaust and near mal-functioning furnaces. By reducing oxygen transport by hemoglobin and by inhibiting mitochondria metabolism, carbon monoxide can aggravate coronary disease. Methylene chloride, a solvent used in paint stripping, is converted to carbon monoxide and thus poses the same risk. Exposure to carbon disulfide, a chemical used in the production of rayon, accelerates the rate of atherosclerotic plaque formation.

Mental stress

Stress is the body's response to real or imagined events perceived or requiring some adaptive response and or producing strain. Environmental factors such as excitatory psycho-emotional influences may be one of the factors responsible for the hemodynamic expression of genes responsible for hypertension. The metabolic and physical consequences of stress can contribute to atherosclerotic plaque rupture. Cardiac ischemia induced by mental stress might be produced by a combination of factors, including increased myocardial oxygen demand and reduced coronary blood flow secondary to coronary vasospasm.

Industrial Hygiene Survey In Coir, Agarbathi And Tea Industry

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Occupational Hazards in Coir Work

Coir is of great economic importance for India in general and Kerala State in particular. India contributes 60% of total contribution. Besides the huge foreign exchange earnings coir work provides a means of sustenance for very large population. The operations are not mechanized but conventional methods of large, heavy looms are employed to weave the coir mats. Before the yarn is spun, the husks are retted in backwaters of the sea for a lengthy period, they are then beaten manually to release fibbers and spun by hand operated spinning wheels to make into ropes which will be the raw material for weaving and mattress manufacture.
The principal work processes in the coir work are:

1. Tree climbing
2. Retting
3. Dehusking
4. Beating
5. Spinnig
6. Bleaching/smoking
7. Dyeing of yarn/Stenciling of mats, rugs
8. Weaving
9. Shearing
10. Finishing (edge trimming, dipping, stitching etc.)

An environmental hygiene study in coir industries (14 small cottage coir units where smoking, bleaching and dyeing processes of the coir yarn was existing) along with collection of environmental samples from open environment where husking and retting processes were going on, near the sea shore was carried out.

The following parameters were studied in these coir industries:

a) Dust and dustiness in work environment
b) Sulfur dioxide concentration in big coir units, where sulfur was burnt in smoking rooms.
c) Prevalent noise levels were monitored
d) Prevalent thermal parameters were monitored.

Table – 1: Mean levels of dust concentration recorded in different sections in coir industries

Section	Total Dust $\mu g/m^3$ Mean (Range)	Resp. Dust $\mu g/m^3$ Mean (Range)
1. Weaving	5.17 (2.50 - 6.80)	1.91 (0.95 – 2.45)
2. Shearing	24.16 (1.28 - 83.70)	2.60 (0.19 – 11.15)
3. Finishing	3.00 (0.075 - 6.96)	-
4. Dyeing	3.94 (3.16 - 5.60)	0.30

Dust particles have an important property of adsoprtion due to their large surface area. They can adsorb harmful gases many times their own weight depending on the specific adsorption. Viewed in his context, the dust in the environment of coir processing along with sulfur dioxide may have significant influence.

The results could be summarized as under:

1. Average air borne total dust and restorable particulate concentration in most of the sections monitored in big and small cottage coir units are found to be less than TLV Prescribed (i.e. 10 mg/m3).

2. Dust concentration was found maximum (24.16 mg/m3) in the Shearing department of big coir units. In other departments total dust concentration was not high.

3. Average values of respirable dust also show higher levels in shearing section (2.6 mg/m3) than weaving section (1.91 mg/m3). The maximum value recorded for respirable dust in Shearing section is 11.15mg/m3 (Table-1).

Fuming with sulfur dioxide (SO_2)in a fuming chamber bleaches mats. In most of the factories fuming chamber is usually located very close to he shearing machine. The sulfur dioxide concentration was monitored only in the smoking chambers of big coir units.

Table – 2: Sulfur-dioxide concentration in different sections in Coir Industries

Section	Total No. of Samples	Resp. Dust $\mu g/m^3$ Mean (Range)
1. Shearing	3	5767 (2100-8000)
2. Smoking Room	14	2706(550-7223)
3. Entrance-smoke room	9	1751 (500-3334)
4. Finishing & Packing	6	2414(1666-5600)
5. Dyeing	2	Traces
6. Gen. Environment	10	1345(20-4000)

It was observed that the sulfur dioxide concentration was very high inside the smoking chambers of these units TLV prescribed for SO_2 by ACGIH is 13 mg/m3). The concentration of SO_2 in the general environment was less than TLV (1.345 mg/m3).

The values near the shearer are in the range of 2.1 - 8.0 mg/m3. The shearer not only works amidst concentrated dusty atmosphere, but also in an atmosphere with considerable S02 levels. That may be the cause of frequent respiratory system complaints of the shearers and other workers working in the smoking room were complaining of irritation of the eyes, throat and nausea.

Sections like finishing, trimming, packing etc. have been classed together and shown as 'finishing' in the Table-1 & 2. The dust levels in those sections are considerably less than those in the shearing section. However, sulfur dioxide levels recorded in these sections are high. Dust levels though low when compared along with high sulfur-dioxide levels indicate that the working environment may be hazardous

The noise levels in both big and small coir unit were within the permissible level of 90 dBA. The noise levels were monitored at shearing and weaving departments.

The thermal parameters were recorded in different departments especially at dyeing and bleaching sections. The WBGT values were not high and the were within the recommended values for the work carried out in these units.

Agarbathi Industry:

Incense and fumigants represent the oldest mathod of perfume release (per, fumum - through smoke). The perfumes are organic chemical compounds whihc produce pleasant olfactory sensation either in the concentrated or suitably diluted forms. The salient features of the agarbathi industry are :

a. Units are concentrated in City of Bangalore and some other parts of Karnataka State.

b. The industry is less organized involving workers of all age groups. Bangalore city has over 300 agrabathi manufacturing industries. 134 out of these are registered under Factories Act. Over 5000 workers are engaged in this industrry at Bangalore.

Objectives of the study were :

1. To assess the dust concentration in work environment at some important workspots
2. To enquire into general health status of workers.

A total number of 13 factories were selected for industrial hygiene (dust monitoring) survey.

Flow chart showing the manufacturing process of agarbathies

Jigatu powder(30%)	Spent wood powder(25%)	Charcoal Powder(25%)

↓

Mixed in water

↓

Rolled on bamboo sticks and dried

↓

Raw sticks (Unscented)

↓

Dipping or sprinkling

↓

Draining and drying

↓

Agarbathies
(Incense Sticks)

↓

Packed in plastic or paper covers
Packed in pre-fabricated containers or cartons
Wrapped in visually appealing paper
Packed in wooden crates → **Transported to dealer**

Results:

Table –3:The mean levels of dust recorded in different sections

Section	Dust L.V.Sampling μg/m³	Dust:Pers. Sampling μg/m³	Dust: Resp. levels μg/m³
1. Mixing	383.47 (170.3-517.4)	1347.83 (226.4-4697.3)	96.16 (49.9-150.3)
2. Rolling	163.77 (97.4-270.3)	632.29 (135.1-852.8)	20.18 (12.9-33.4)
3. Packing	123.54 (65.4-210.7)	343.32 (321.6-367.1)	15.94 (10.8-27.4)
4. G. Envt. (Admn.)	56.90 (47.5-110.2)	-	-

Low volume air sampling(representing background dust concentration is work environment) method has shown comparatively lesser concentration when compared to personal sampling method indicating subjective exposure concentration is more. That is dust concentration in the breathing zone as a hazard is prevalent at the work spots monitored.

However, the proportion of total respirable particulates is comparatively lesser at all the corresponding sections. This suggests that the nature of particulates as being larger in seize and heavier in mass; hence tend to settle down soon after evolution during working. Of the three main sections monitored, mixing of raw materials for making a dough is the work which liberates considerable dust particles to which those particular workers are exposed. This operation is chiefly done by by women.

A large varieties of organic chemicals which liberate the aroma are used (predominently the esters, aldehydes, ketones, synthetic and natural oils like cedar wood oil, clove oil, amir, bliss, rose oil etc.) which are the derivatives eg. aldehydes, amyl benzoate, benzyl butyrate, methyl phenyl acetate etc.. are used in large quantities. Besides these many unknown formulations under various trade names are also utilised. Solvents for diluting the perfumes and oils used are dimethyl phathalate, dimethyl sulphate.

Suggestions:

Dust control measusres such as the operation to be carried out in well ventilated areas (preferable exhaust ventilation facility) and workers be provided with dust masks (filter pad type) as personal protective device and asked to wear while they mix the chemicals is suggested. Hand gloves and aprons(impermeable) are suggested to be worn when the workers are to work with the organic chemicals.

Tea Industry

India is one of the largest tea producer of tea in the world accounting for nearly 33% of the global production.

Brief description of tea production:

The tea plant grows well only in the slopes of hills in the elevation of 1000 m to 3000 m. It is a bushy plant about 4 feet tall and 6 ft. across. Only the tender leaves can make a good tea. These te4nder leaves in the form of "two leaves and a Bud" are hand plucked periodically, usually onceonce in 2 to 3 weeks. The tea plucking is done by women. The plucking rate varies from 20 to 80 kg worker per day but the average is about 25 kg. and the same is sent to the factories for further processing.

Factory work:

Withering: The tea leaves are spread on the lofts through which a current of air is forcibly blown to reduce the moisture content of the leaves. This process lasts for 8-10 hours, and the mss is reduced by one half of the original weight.

Rolling : The whithered leaves are then fed to the rolling machine which partially crush the leaves and twists them. The rolling is done to rupture the cells in the leaves. Fermentation: The rolled leaves are heaped in special trays and kept in fermentation chambers where temperature and humidity are carefully controlled. this is an important step which determines the flavour of the tea.

Drying/Firing : The fermented leaves is quikly dried in a drier. the drier is a long conveyor belt heated by hot air drawn from a furnace, the conveyor is so arranged to give graded heating. The furnace is heated by burning coal, firewood or oil. The modem furnaces are electrically heated.

Sifting: The dried tea leaves are subjected to cleaning process to eliminate stalks which are handpicked or removed using electrostatic separators called Fibrex machines. The cleaned tea is now graded by sieving through sieve of different meshes. This is the sifting operation. This is a dusty operation during which a cloud of fine tea dust called fluff arises.

Packing: The graded ted leaves are packed in aluminium foillined wooden chests and sent to the market. Furnace operation: In addition to the above operations a furnace is kept continuously operative at 250 deg. F. Coal is fed once in 10-15 minutes using a shovel and the slag is removed periodically.

Work disribution: Workers are not strictly alloted or confined to specific sections in the factory; they work in different sections and may be shifted from one section to another according to work load and experience. In the present industrial hygiene survey, 4 factories were included for monitoring. The parameters monitored in different sections re dust monitoring(particulate size), thermal measurements and noise levels.

Results:

Table-4 Dust particulate concentration in different sections of the tea industries

Department	Pariticulate Concentration (mppcf)
1. Sifting	29.62 (3.70 – 5.50)
2. Firing	4.93 (1.70 – 9.00)
3. Rolling	3.05 (1.30 – 5.50)
4. Whithering	2.34 (1.10 – 3.80)
5. Packing	1.88 (1.80 – 2.60)

Dust levels were high in sifting rooms (59.5 mppcf). The levels in other sections ranged between 1.88 to 4.93 mppcf (Table – 4). A notable feature in the dust is that generally it is respirable in character. At these dusts contain alkaloids of tea, the effect of inhaling such dust should form an interesting study.

Envvironmental physical parameters ((Range of values):

A. Temperature : The overall range of radiant temperature (GT) recording are 19.5 deg C – 46 deg. C . The firing /drying sections are the hottest because of the presence of the furnace. The highest radiant temperature here recorded was 46 deg. C.

Department	GT(°C)	WBGT(°C)
1. Sifting	19.50-35.00	17.10 – 26.60
2. Firing/Drying	28.00-**46.00**	20.43 – 30.90
3. Rolling	18.50-26.50	17.20 – 21.80
4. Whithering	20.00-28.00	16.30 – 23.50
5. Packing	27.00-31.00	22.10 – 24.50

B. Heat stress: WBGT index ranged from 16.3 to 30.9 deg . Except the firing /drying section these were well within normal limits in all the other sections.

C. Humidity: Ranged from 23% - 96%; but the overall valued was within the normal limits. Higher readings were obtained in the withering (44%-88%) and rolling sections (33% - 96%).

Table – 5: Noise levels at different work spots

Department	Noise dB(A)
1. Sifting	78 - **102**
2. Firing	70 - 84
3. Rolling	78 - 86
4. Whithering	76 - **92**
5. Packing	98 - **102**

D. Noise levels: The noise levels at the points measured (a total of 36 points covering all sections) were higher than 70 dB. 31 points had a level between 70-90 dB and 5 points had levels above 90 dB. These were the fan end of the withering section, sifting and milling machines, packing section).

Further Suggested Reading:

1. Annual Reports: National Institute of Occupational Health, (ICMR), Meghani Nagar, Ahmedabad, 1979 , 145-152.

2. Annual Reports: National Institute of Occupational Health, (ICMR), Meghani Nagar, Ahmedabad, 1980 , 139-162.

3. Rathnakara, U.P, Krishnha Murthy, V, Rajmohan, HR, Lalitha Nagarajan and Vasundhra MK.
An enquiry into work environmental status and health of workers involved in production of incense sticks in Ciry of Bangalore, Indian Joumal OF Public Health, Vol. Xxxvi, No.2, Apri- June, 1992, p.38-44.

4. Report: Health Status of Tea Plantation Workers With Special Reference To Their Occupation, Part I – Joint Study by Ross Institute of Occupational Health (St. John's Medical College), Bangalore and Regional Occupational Health Centre (S), Bangalroe, 1979-1982.

Health Hazards Of Workers Engaged In Coir, Agarbathi & Tea Plantations

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This paper highlights the observation made by the scientists of Regional Occupational Health Centre (South) with respect to the health hazards of workers engaged in coir, agarabathi and tea plantations. Every occupational health problem needs to be understood both from the point of occupational environment (work environment) and also the dwelling environment where the person spends most of the time. In this paper, the relevance of observations made by the Centre through their multidisciplinary groups on the basis of epidemiological guidelines are being discussed individually.

Health Hazards Of Workers Engaged In Coir Operations

Coir Industries

Coir is coconut husk, discarded after consuming tender coconut water and the copra. This coir is of very great national economic importance for India in general and Kerala in particular. The importance of coir industry is also felt in other states. The coir industry used to dominate only in coastal states because of coconut cultivation, climatic factors and other facilities for its processing with available natural resources. Nearly 60% of the world's production is met by the Indian Coir industry.

Wherever the coir industry has existed, it provides means of sustenance and lively hood. Because of the economic importance and enterprising nature of the industry, industries developmental activities are being looked after, encouraged financed and regulated through the Coir Board a autonomous board under Union Government of India. Few states have also their State Coir Board for the same purpose.

Coir Workers

Traditionally the coir workers are from the lower socio-economic groups of population belonging to the areas where the industry is dominated. It is a age-old occupation. It has seen the lime light in the last 2-3 decades. The work force includes both male and female workers of the family. Hence, it can be said that coir industry is more a cottage industry participated by the rural family units. Though there are specified jobs, same individual carrying out multiple operations still exists because of their convenience, operational reasons, individual skills and economic reasons. From the point of work force participation, coir industry is dominated by family participation.

It can be observed that the persons who are partially disabled because of elephantiasis are also employed in the industry. It infers that the disabilities are not the hindrances and when there is no other job opportunity elsewhere the person can think of earning lively hood through a job in coir occupation. This peculiar and interesting circumstances are highly complex and difficult to understand, to identify the specific occupational health problems associated with coir operations.

Climate

As discussed earlier the workers are exposed to the prevailing general environment, particularly in the coastal areas, it is warm, humid and sultry environment. Most of the seasons with moderately heavy rain seasons. The factory environment to some extent exposes the workers to the dusty and warm environment in few jobs. The influences of work environment and dwelling environment are very much there on these workers.

Coir Work

Coir work is mainly carried out in two places, one is at the place of dwelling and second at the factory. The main occupation generally practiced are tree climbing, dehusking, retting, beating, hand spinning, wheel spinning, weaving, dyeing, finishing, stencilling and other category of unspecified jobs.

In the coir factory, the occupations include curling, dry beating, wet beating, drying, spinning, bundle rolling, packing, bailing and hecking of bristles.

Morbidity Conditions

Some of the commonly noticed morbidity conditions in coir industry are fever with cough, gastrointestinal disturbances, non-itching patch and other skin diseases, asthmatic and chronic bronchitis and elephantiasis.

The prevalence of chronic bronchitis was observed more among male workers compared to control workers. Trends of higher morbidity rates among retting, finishing and weaving male workers.

Bulk of the morbidity among female workers was observed in spinning occupation. The observations were pointing in favour of synergic interaction between smoking, geographical, climatic and ethnic factors.

No particular coir work had a higher risk of diseases nor any particular coir operation was absolutely free from disease.

The Centre also attempted to introduce a ergonomic device called hand grip made out of wood for the coir yarn spinners who fed the raw husk with their hands to the moving charakas. These workers were prone to develop deep cut injuries of both the palms. The raw fibre was creating not only injury and suffering, but also disability, loss of wages, financial problems, absenteeism and loss of Productivity at large.

The observation of the trials conducted with this ergonomic handgrip were :

1. The device reduces injuries of palms and there by alleviate the agonising pain and suffering.
2. It was felt that the device need reduction in size, weight and modifications.

HEALTH HAZARDS OF WORKERS ENGAGED IN AGARABATHI MANUFACTURING

Agarabathi/Incense sticks are manufactured normally in cottage industries. Karnataka has a large number of industries, ranging from small to large employing 10 to 100 workers. Industry is less organised involving workers of all age groups working at their place of residence. Incense and fumigants are traditionally practiced methods of perfumes release by way of burning incense sticks. The perfumes used are organic compounds which produce pleasant olfactory sensation. The organic chemicals are predominantly esters, aldehydes and ketones. Synthetic and natural oils like cedar wood oil, clove oil, amir, blins, rose oil etc. are also used. Besides these many mixtures of chemicals of unknown formulation are also used in the industry. The raw materials are jigatu-the bark of Machilus Makarantha as a binding agent, spent sandal wood (sap wood), charcoal powder as a glowing agent, (occasionally the saw dust), bamboo sticks, colouring agents and packing materials are used.

Work Force

Mainly belongs to low socio-economic strata of society. They undertake the job on piece basis and in bulk. The majority of workers earned a meager income.

70.20% of workers are reported to be earning Rs.1200/- per month.

High prevalence of illiteracy among workers existed. 89.20% of males and 51.54% of females were illiterate.

Occupation

Mainly	a. Mixing of raw materials and agarabathis	32%.
	b. Dipping into and sprinkling of perfumes	10%
	c. Sorting and packing	43%
	d. Managerial & administration	6%
	e. Miscellaneous (loaders, crate packers, sweepers, drivers)	9%

Rolling, Dipping and sprinkling exclusively carried out by females. Sorting and packing is done by males.

Occupational Hazards

The subjective complaints narrated by the workers were :

1. Low back ache	22.16%
2. Tiredness/sleeplessness	22.10%
3. Headache	20.35%
4. Irritation of eyes	19.91%
5. Joint pains	15.32%
6. Chest pain	11.59%
7. Running nose	7.22%
8. Abdominal pain	7.00%
9. Tremors	3.72%

The complaints of female workers were more when compared to male workers.

Low backache among the agarabathi rolling workers (females) was the commonest complaint possibly attributable for their squatting posture during the course of work.

Sex wise distribution of illness observed by clinical examination were - dyspepsia 4.37%, acne vulgaris 3.5%, hypertension 3.25%, acute tonsillitis 3.06%, DNS 3.06%, cataract 2.84%.

Among male workers acne vulgaris 7.73% and acute tonsillitis 5.67%, DNS 3.09% were the commonest clinical findings.

Among female workers, dyspepsia 6.08% was the commonest followed by cataract 4.56%, hypertension 3.80% and dermatitis 3.8%.

The complaint of low back ache more in dipping and rolling workers was significant.

The symptoms like head ache, tiredness, joint pains and running nose were equally distributed in all the sections.

The higher prevalence of eosinophilia among workers in all sections was a salient feature (42.53%). This needs to be interpreted only after de-worming for any prevalent worm infestations, for identifying the possibility of occupational allergens if any.

HEALTH HAZARDS OF WORKERS ENGAGED IN TEA PLANTATION

Introduction

This is one of the most important plantation crops in India and has a national economic importance. Nearly 3,63,303 hectares of land is cultivated for tea. 33% of global production is contributed by India. In India the plantation are situated in Eastern India, Assam, Western ghats of South India (Nilgiris and Annamalai Hills of Tamil Nadu, Kannandevan Hills of Kerala).

Tea is grown at high altitudes (elevation of 1000-3000 mt). The plants are 4' tall, 6' across and grows like a bush. Tenderleaves make good tea. Normally the tea leaves are plucked in Apr-June. Processing is done in factory. The cultivation is like any other agriculture activity with special features.

Tea Plantation Workers

Workers are mainly from low socio-economic group of society, tribal and hill region population, some are migratory work force from neighbouring states. Both male and female workers are actively involved in plantation activity. Here also the labourers involvement is more like a family involvement rather than individuals. Approximately 8 lakh workers are employed in tea plantation alone. Nearly 56% of them are women work force. The tea plantation comes under the Tea Plantation Labour Act 1954.

Occupations

The occupations are mainly of 4 categories viz., Field Workers, Factory workers, supportive workers and administration work force which includes supervisory and managerial staff.

The details of specific occupations is given below :

Occupations In Tea Plantation

Field Worker	Factory Worker	Supportive Services	Admin./ Supervisory/ Managerial
Plucking	Withering	Sweepers	Office Staff
Cleaning	Rolling	Gardeners	Managers
Planting	Fermentation	Helpers	Supervisors
Manuring	Drying/	Watchman	Conductors
Weeding	Firing	Driver	
Pruning	Sifting/	Store keeper	
Lopping	stalk	Electrician	
Spraying	extraction	Mechanic	
	packing	Plumber	
	Furnace	Medical staff	
Misc.	operation	Welfare staff	
Manual &			
Driving			

Plucking in the field and sifting/ stalk extraction in factory are mainly done by women work force. Pesticide spraying is done by male workforce.

Occupational Health Problems/Hazards

The occupational health hazards commonly noticed among tea plantation workers are mainly from physical, chemical, biological, mechanical and psycho- social environment prevailing in plantation work place and place of dwelling. The place of dwelling normally is the plantation itself. The employees encounter almost all the public health problems which are common elsewhere. The details of causative factor is given below. Long hours of hand work in incliment weather further adds to the adverse influences on health.

General Environment

Geographic location/ Altitude	:	1000-2000 mt. Above sea level
Temperature	:	Ranges from 54-95% (54-summer);(95-winter)
Humidity	:	June-September also during winter season
Rainfall	:	100-110 mm.
Air Velocity	:	Cool breeze most of the year with stronger winds
Water Supply	:	Mountain springs, tube and open wells
Housing	:	Labour colonies, Pacca housing Damp proof floor & tile concrete or asbestos roof
Sanitation	:	Septic tank

Chemical Environment

Fertilisers	Pesticides	Herbicides/ Weedicides
ORGANIC - Manure from farm animals - Bone meal, - Composts	- Insecticides - Miticides - Rodenticides - Fungicides - Bactericides - Nematocides	- Chemicals used for weed control

MINERAL

- Nitrogen
- Phosphorus
- Potassium

Biological Environment

- Very complex, include Flora and Fauna
- Wild animals/Game - accidental invasion, Mauling
- Domestic animals / live stock- injuries, zooming

- Snakes
- Insects and Pests (9)
- Diseases of tea bush (primary fungal - 16)
- Helminths
- Insect vectors disease (Malaria and Gastro-enteritis)

Mechanical Environment

- Mechanisation
- Agriculture / Plantation implements
- Gradients

Psycho-Social Environment

- Life style
- Relationships
- Attitude
- Education
- Isolation
- Status of women
- Dependence
- Social stratification (labour/staff/management)
- Diversity

Occupational Health Hazards

These are similar to occupational health hazards common to other agriculture labour. In addition to these, the specific influencing factors which have a direct bearing on the health of tea plantation work force are incliment weather, poor environmental sanitation, chronic effects of handling agricultural chemicals, hazards due to close proximity to animals, increasing mechanisation and stress related problems.

The Most Common Health Hazards (Symptoms & Signs) Are :

- Leech bites, snake and scorpion bites
- Insect stings
- Worm infestations
- Accidents (Men)
- Backaches
- Joint pain
- Anaemia
- Menstrual disturbances

- Leukorrhoea
- Head aches
- Anonexia
- History of parasthesia & neuritis
- Varicose veins
- Insomnia
- Signs of Vitamin B deficiency
- Infective lesions of skin
- Respiratory infections
- Burning micturition

Coir dust being vegetable dust was thought to be a respiratory allergen, but does not seem to have any effect on pulmonary function tests.

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EPIDEMIOLOGICAL PATTERNS ASSOCIATED WITH AGRICULTURAL ACTIVITIES IN THE TROPICS

D.J. Bradley and R. Narayan

EPIDEMIOLOGICAL PATTERNS ASSOCIATED WITH AGRICULTURAL ACTIVITIES IN IN THE TROPICS WITH SPECIAL REFERENCE TO VECTOR-BORNE DISEASES.

David Bradley[1] and Ravi Narayan[2]

Introduction

For most rural populations of the tropics, agriculture is the normative occupation. Therefore our picture of the health and diseases of tropical communities consists of the epidemiological patterns associated with agricultural activities. The patterns are complex and diverse. Tropical peasant agriculture is usually characterized by a high infant and child death rate, malnutrition which may be seasonal, acute respiratory infections and diarrhoea as the main causes of death, particularly of children, frequent tuberculosis and skin infections, trauma and disability, and infection by a variety of endemic parasitic worms and protozoa at high prevalence but showing much regional variation. They will include many vector-borne diseases among which malaria, filariasis, arbovirus infections, schistosomiasis and the other human trematode infections, and the haemoflagellate infections are of particular importance (Table 2). Typically, the subsistence farmer will live with his family on or near to his fields and there will be no sharp boundary between his occupational and general health.

To separate the two is neither feasible nor particularly useful. The person's health problems are experienced as a whole and they are the concern of the Ministy of Health. Some diseases may be linked to specific components of life and of activity and may be open to change, but in general there will be a health care system concerned with all the local diseases and health problems and the agriculture-related diseases can only be approached by observing health changes if the people migrate to a city and nothing else changes in the environment. Even then, the multiplicity of changes is so great that to relate all the differences to loss of agricultural activity will be clearly mistaken.

While it is difficult in the subsistence situation to separate agricultural occupational health problems from the remainder of the community's health, once changes in agricultural activity take place the consequent health changes may be more readily identified and measured. We now therefore concentrate on the health consequences of changing agricultural activity. Health problems may get worse or better - too often different factions of those who study the problem only focus on one of these aspects. We first analyse the types of agricultural change and their health effects, then illustrate the effects of common groupings of changes, and thirdly review a set of particularly important types of agricultural change and their epidemiological implications.

We present a broad rather than a detailed picture, both because of space limitations and also because many of the papers that follow will describe particular aspects of the problem or specific examples.

Agricultural change tends primarily to involve alterations in the basic environment, domestic plants and animals, and farming methods (Table 1). The two main types of environmental modification are the provision of increased, or more controlled, water for vegetation growth and the opening up of additional land.

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Water resource developments

Water resource developments have been much studied and may comprise impoundments of water in artificial lakes, sometimes of huge size, and irrigation systems to bring the water to the fields and plants. The resulting increase in availability and diversity of surface water both in area and in duration through the year tends to lead to increased populations of still-water vectors, particularly mosquitoes and water snails. The torrent-breeding Simulium vectors of onchoceriasis may have their habitats destroyed by inundation. The converse aspect of water management, drainage of swamps and waterlogged areas, will reduce breeding of mosquitoes and the amphibious snail hosts of Schistosoma japonicum. While increased surface waters with more vector habitats and increased vector populations will tend usually to more mosquitoes biting man, contact between snail parasites and man will be dependent on the detailed changes in water availability - man/vector contact may even be reduced due to a dilution effect.

Land Use Extension

Extension of land use brings different vector hazards, chiefly resulting from man's intrusion into new ecosystems with disturbance of parasite life cycles maintained as zoonoses in the undisturbed environment. Leishmaniasis provides a clear example, both in the deforestation on the Amazon region where agricultural settlers are exposed to Leishmania braziliensis causing muco-cutaneous disease and in the southern USSR where cutaneous leishmaniasis, transmitted by sandflies between huge populations of the colonial burrowing gerbil Rhombomys opimus is a major hazard to farming settlement (Lainson et al., 1963). More lethal problems from sleeping sickness have resulted from agricultural resettlement or patchily cleared secondary forest in South Busoga, Uganda. Audy has emphasized the importance of eco-tones in the epidemiology of vector-borne zoonoses and land use extension creates extended ecotones, edge-effects between different ecosystems (Audy, 1968). Malaria outbreaks in Thailand due to Anopheles dirus (formerly called A. balabacensis), and to be described by Sornmani, are of this type also.

An ecologically comparable situation is where man enters a habitat for some form of agricultural activity of a more hunter-gathering type and thereby enters a zoonotic life cycle habitat. The chewing-gum collectors of Honduras are exposed to Leishmania mexicana, which mutilates their external ears, in this way (Garnham, 1971). Another example is Kyasanur Forest Disease, an arboviral infection in Karnataka State, South India where affected men and cattle have previously come in contact with Haemaphysalis spinigera, a monkey biting hard tick during excursions into the forest (Singh, 1971).

Domestic animals and cultivated plants

Changes in plants and animals for domestic use may affect vector-borne diseases, usually because they require changed cultural practices. Many of the high-yielding varieties of rice and wheat, which are the key feature of the "green revolution" have requirements for water and fertilizer that prolong the period of available surface water for vector breeding.

The time scale of health impacts on agricultural change are both variable and complex. A common effect of water resource developments is to decrease seasonal effects, to make irrigation water available in the dry season. So vector presence changes from seasonal to perennial. Often the loss of seasonality will be accompanied by increased vector populations, but least as harmful as the perennial transmission of the forest zone in West Africa. The degree of persisting seasonality will depend on small scale decisions. For example, with the multiple cropping of irrigated rice the fields may be planted synchronously, or they may be totally staggered with the consequence that there will always be rice present at the particular growing stage that provides the best habitat for a particular vector. The loss of seasonality may also remove the "hungry period" and its accompanying seasonal overwork and synchronous malaria transmission - that lethal combination which so raises the seasonal death rate in the savannah of West Africa and elsewhere.

Some changes will be of a secular type on a very long timetable. Thus the eutrophication sequence of lake Volta in Ghana is now settling after some 15 years, during which there were massive increases and now falls in the submerged macrophytes which acted as habitats for the snail intermediate hosts of urinary schistosomiasis (Bulinus truncatus rolfsi) (Obeng, 1975).

The trend towards multiple cropping which depends on both irrigation and appropriate crop varieties can, in the case of rice, increase the period when the ricefields provide breeding habitats threefold in the absence of measures to restrict mosquito larval survival. However, selection of crop rotations within the year can reduce the time when free surface water is present.

Changes in livestock may affect vector-borne disease patterns in complex manner. Increased animal populations may direct mosquito biting activity away from man, especially if the livestock pens are sited between the breeding sites and human settlements. On the other hand, the stock may act as amplifier populations, allowing the great proliferation of arboviruses normally transmitted at a lower level among wild birds or mammals. Subsequently the infection may spill over into the human population, as may occur with Japanese encephalitis virus, amplified in domestic pig populations. Livestock populations, by increasing food supplies for mosquitoes and tsetse, may also encourage larger vector population than otherwise would be the case, but little quantitative data are available. In the case of schistosomiasis in East Asia, domestic animals are susceptible and may play a role in maintaining the parasite life cycle in the Philippines and elsewhere.

Farming methods

Changes in agricultural methodology, such as increased mechanization and the use of pesticides, herbicides and fertilizers, will often affect vector-borne disease transmission but it is difficult to generalize about the precise consequences. For example, insecticides applied for agricultural purposes may initially also reduce vector insect populations substantially, they may select insecticide-resistant strains, and they may continue to reduce natural populations of other invertebrates that limit the vector breeding success. The outcome after a time may be more rather than less disease transmission, but the time scale of such changes may vary greatly. Herbicides may render the irrigation channel less suitable for vector breeding (or more so for other species), they may be lethal to snail hosts of trematodes, and the medium-term ecosystem changes may influence the vector populations in complex ways. Eutrophication from fertilizers may indirectly increase snail breeding and have complex effects on the balance of aquatic organisms.

Increased mechanization, to be discussed fully by Service, has both direct effects through changes in the ricefield or other agricultural environment that may decrease snail populations by better clearing of vegetation from canals, for example, and indirectly may lead to larger fields, better levelling, drainage of marshy areas, and a sharper separation of land and water which will generally tend to decrease vectors of disease.

Most forms of mechanical equipment will also tend to reduce personal contact of farm workers and the aquatic environment. Thus, schistosomiasis transmission will be reduced, so will leptospirosis with its rodent reservoirs, but no invertebrate vector. Where mechanical means are used to harvest crops or cut sugar-cane there will be a decreased risk of snake-bite (a substantial hazard in some parts of Asia). Increased sophistication of methods short of mechanisation may also reduce schistosomiasis in those working in water while better clothing will decrease leech bites and insect bites among plantation workers such as tea-pluckers.

As agricultural activity and culture methods become more sophisticated and higher yields are systematically sought, a more evenly cultivated landscape will result. The ecotones, patches of waste land and water will be reduced and many disease vectors will decrease. There may however be larger populations of a few vectors whose ecological preferences happen to coincide with the spreading pattern of agriculture.

Changes in people, agents of disease and vectors

Types of agricultural change are outlined above. Either in order to achieve them or following their introduction, substantial human population changes frequently occur. The most obvious are immigration of farmers to newly opened up or newly irrigated lands. Often they may come from over-populated hill areas where endemic malaria and other primarily warm climate diseases are uncommon. Such immigrants suffer heavily - "malaria of the tropical migration of labour" is, for example, a well-known and named entity. The malnutrition which often occurs in the first years in a new site takes its toll and may exacerbate other diseases. The immigrants may precede the provision of health services. Unplanned immigrants, especially fishermen invading water resource developments, may suffer from vector-borne diseases such as schistosomiasis but benefit in economic terms (Pesigan, 1958). Even more unfortunate are indigenous inhabitants displaced by the agricultural innovations of the water resource developments undertaken to provide them. Their health problems are compounded by poverty and upheaval. Resettlement is usually inadequate and a health service to take particular care oo new disease hazards is unavailable.

Where the agricultural shift is to cash crops from subsistence, family nutrition usually suffers, at least in the short run, from the loss of local cereals and pulses, sometimes from increased labour demand and less time for child-rearing. The effect of malnutrition on vector-borne diseases is complex and agent-specific, they are not always made worse.

Patterns of settlement often change from scattered homesteads to compact villages. Health care can be made more accessible but some forms of disease transmission - hookworm and other geohelminths, the childhood virus fevers, and other infectious conditions may become more frequent. Common source disease outbreaks will be larger.

Many activities, and their health consequences, will tend to become less seasonal than before, and the "hungry season" that coincided often with maximal transmission of vector-borne disease, may become less pronounced.

New pathogenic organisms may infect man: new in the sense that they were previously unknown in the locality. This may be because of the environmental changes in agricultural practice described above, introduction by immigrant farm workers, or amplification of zoonotic viruses by introduced livestock. Infections already present may become more prevalent, and in the case of helminthic infections the parasite burden may be increased, with a resulting risk in overt disease. Thus the Egyptian transition from annual flood irrigation to perennial irrigation in the Nile valley haa led to a changed balance between schistosome species and a greater intensity of infection.

Vector populations may increase in numbers, or in a few cases decrease, have an extended season of activity and undergo the many complex changes to be described in subsequent papers at this conference.

The emphasis in the above summary has been oo the health effects of agriculture as mediated by change in the natural and biological environment. But agricultural change has social and economic effects and their effect on human health may be yet more important. Effective agricultural development will raise aggregate income, with potential health benefits, but it often also increases disparities of income and the poor, usually landless labourers, may become yet poorer and marginal farmers become worse off, with consequences for nutritional status and access to health services. Consequential inevitable urbanization of the poorest farmers, with its different health hazards, may be a consequence of agricultural change.

A further group of indirect health effects follow from the various types of seasonal migration related to agriculture, from the regular traditional transhumance of mountain pastoralists to the much larger scale seasonal labour requirements for planting and harvest of sugarcane in Thailand, cotton in the Sudan, and various crops in Asian Turkey. In the last case, problems of welfare taxation greatly complicated control of malaria; both there and in Thailand, as is often the case, migrant labour chiefly suffers from the endemic malaria even though local perception may be reversed, with the migrants being blamed for the malaria which they have in fact contracted only on arrival. Housing for such temporary migrants is not only often very bad, but the transient structures may lack proper walls ans be difficult to spray with residual insecticides against mosquito vectors. Permanent agricultural housing over large tracts of South America is liable to colonization by reduviid bugs, who by their nocturnal blood feeding on inhabitants may transmit Chagas' disease.

Where livestock shares the farmers' dwelling at night, other vector-borne disease problems are locally significant. Cattle ticks of the genus Ornithodorus in Tanzania will travel up the bedposts, especially if they are fixed into the ground, and transmit relapsing fever among the inhabitants. In areas of sheep herding domestic dogs become important in the transmission of hydatid disease to man while rabies is a hazard also.

The patterns of disease observed in different agricultural communities will depend upon the specific agricultural variables listed in Table 1 together with the local features of climate, degree of socio-economic development, and cultural variables. Certain broad patterns may emerge, in different geographical regions, though the vector-borne diseases in particular will tend to show micro-geographical variations in both the types and prevalences of diseases encountered.

Implications of agricultural types

Asian rice cultivation will be dominated by malaria, schistosomiasis and Japanese encephalitis, with smaller contributions from gastro-intestinal and hepatic flukes. But all these diseases are patchily distributed and in many areas malaria is prevalent but unrelated to agricultural activity. Similar problems occur with irrigated rice elsewhere, though different arboviruses will replace the Japanese encephalitis, especially in the Americas, and the filariases will play a variable role.

The problems of extending cultivable land into forested areas are likely to include zoonoses such as leishmaniasis, sleeping sickness and some arbovirus infections while some Asian malaria vectors flourish in such ecotones as does scrub typhus.

Plantation agriculture has usually followed control of malaria, and particular health hazards are related to labour-intensive activity in close contact with trees and shrubs where insect stings, leeches and snakebite may be frequent. A range of vector-borne diseases may occur but are more easily controlled than in the unorganized rural agricultural sector of contiguous areas.

The move to highly mechanized advanced agriculture is accompanied by massive falls in the farming population, larger plots and more capital-intensive methods than usually tend to reduce the hazards of vector-borne disease. Contact with vector snails will tend to fall, even if they are present in the water bodies, and the main residual problems will be vector mosquito breeding if rice or similar crops are grown and health hazards from seasonal labour migrants where these are needed for harvesting. Mechanization and/or sophistication of technology are invariably involved with greater capital intensive production reducing labour demand and hence increasing rural unemployment, especially if alternative employment through rural or urban industrialization cannot keep pace. This could further complicate the situation of poverty and disease.

Particular issues of agricultural change.

Various Arcadian memories or dreams exist concerning healthy agricultural practices and environments in the past, and hunter-gatherers seem to often have lighter levels of parasitic infections that do those in settled agriculture. The ancient hydraulic agricultural communities of Sri Lanka were said to have a relatively low incidence of vector-borne disease as a result of having a network of small units serving limited populations, without use of pesticides and fertilizers but with careful maintenance of tanks and canals and carefully followed cycles of seasonal flooding and drying out of the channels. Similarly, in more recent times the Sudan Gezira Board achieved good control of schistosomiasis and of malaria by a complex of environmental and behavioural measures enforced with an iron hand in the earlier years of that irrigation scheme. It is far from clear how far, in the absence of coercion or very strong other incentives it is possible to have an environmentally and behaviourally determined relatively safe agricultural programme in the tropics involving water resource development but certainly this area needs further study.

The practical issues of attempting a return to this Arcadia are raised by considerations that have increased since the availability of greater evaluated experience of "the green revolution" and the awareness of an increasing range of detrimental effects that have accompanied the increased food availability - not the least of which are the pesticide "treadmill" effect, pesticide hazards, and the socio-economic effects mentioned earlier.

The quest for sustainable agriculture - that produces higher yields but with very limited fertilizer and other modern sector inputs has been gaining ground through experiments in Japan, India, USA and UK. This situation may be good for environmental control of vectors but little directly relevant research is yet available and needs to be planned for.

Development strategies involving both agricultural and industrial interventions are increasingly beginning to focus on those sections of society who do not adequately participate or benefit from the existing modes of development. While environmental and socio-economic changes in the community have been adequately documented, only in some limited specific cases has data about the health and nutrition effects of agricultural development been applied in impact evaluation. Much more needs to be done.

The analysis of health consequences of agricultural change has predominantly considered one disease at a time and traced the biological and behavioural determinants of transmission. Less often, a single change in agriculture or a single intervention has been considered in relation to all its health consequences, as when the effects of increasing irrigated rice fields or introducing piped water are considered. But the farming family see their health as a whole in relation to themselves rather than a single agricultural change or occupational hazard. Moreover the farming community is essentially a stratified community divided into different groups by socio-economic status, land ownership and wage relations. Agricultural change whether single or multidimensional, affects different groups in different ways - quantitatively and qualitatively. There is a need for community based epidemiological studies that will consider agriculture as one of the many determining variables for health and measure its impact on the stratified agricultural community. This is not only to give a sense of proportion but also to view the problems and thus seek solutions from the viewpoint of the farmer and the agricultural community.

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TABLE 1: Epidemiologically Relevant Aspects of Agricultural Change

	New or Qualitatively Changed	Increased Quantitatively
PRIMARY AGRICULTURAL CHANGES		
ENVIRONMENT		
Water resources development	Reservoirs, dams. Land drainage. Irrigation schemes	Irrigation canals
Land use extension	Clearing, deforestation Extensive ecotones	
ORGANISMS		
Plants	New High-yielding varieties Move to cash crops Intercropping	Multiple cropping
Livestock	New breeds	Increased animal husbandry
CULTURAL METHODS		
Chemicals	Pesticides Herbicides	Fertilizers
Machinery	Mechanization	
SECONDARY EPIDEMIOLOGICAL CHANGES		
People	Settlement Changes in Seasonal Patterns Nutritional status	Immigration
Vectors	Species changes	Population changes
Disease agents	Species changes New introductions New hosts acquired	Amplification by stock

Table 2. Major vector-borne diseases that may be related to agriculture

Protozoa	
Malaria	Anopheline mosquito vector may breed in standing water
Sleeping sickness	Tsetse-borne disease related to extending land use into forest
Chagas' Disease	Transmitted by bugs living in walls of houses, especially when livestock there
Visceral leishmaniasis	Sporadic, sometimes epidemic in semi-arid regions, sandfly transmitted
Cutaneous leishmaniasis	Rodent reservoirs disturbed in Asian land use
Muco-cutaneous leishmaniasis	Forest zoonosis of Amazon forests, to man during deforestation
Trematodes and Cestodes	
Schistosomiases	Major irrigation problems spread by aquatic and amphibious snails
Hydatid	Dog tapeworms, larva usually in sheep, harmful to man in sheep-herding areas
Other tapeworms	Problems where undercooked beef and porc concerned
Other trematodes	Transmitted by snails through undercooked freshwater animals
Nematodes	
Guinea-worm	Transmitted through defective water supplies by water-flea type crustacean. Big effect on agriculture
Filariases	Transmitted by anopheline and culicine mosquitoes
Oncherciasis	Transmitted by fast-water breeding *Simulium* flies
Other microbes	
Relapsing fever	Tickborne problem where stock and man share accommodation
Yellow fever	Hazard at forest edge (and in urban areas)
Dengue Japanese encephalitis Other encephalitides Other arbovirus infections	Viruses transmitted by mosquitoes, mainly culicines, breeding in irrigated fields and standing water
Scrub typhus	Mite-borne zoonosis of the forest edge
Non-vector-borne diseases	
Leptospirosis	Especially problem of marshy and irrigated agriculture
Rabies	Hazard of pastoral areas where dogs used
Snakebite, leeches	Hazard in forest plantation agriculture