Chapter 2

Concept and theory

This Chapter mainly deals with the conceptual framework used in this study in order to provide a theoretical base for the empirical investigation and guidance for the selection of relevant predictor variables as well as to envisage a set of hypothesis for testing. This chapter includes the following–

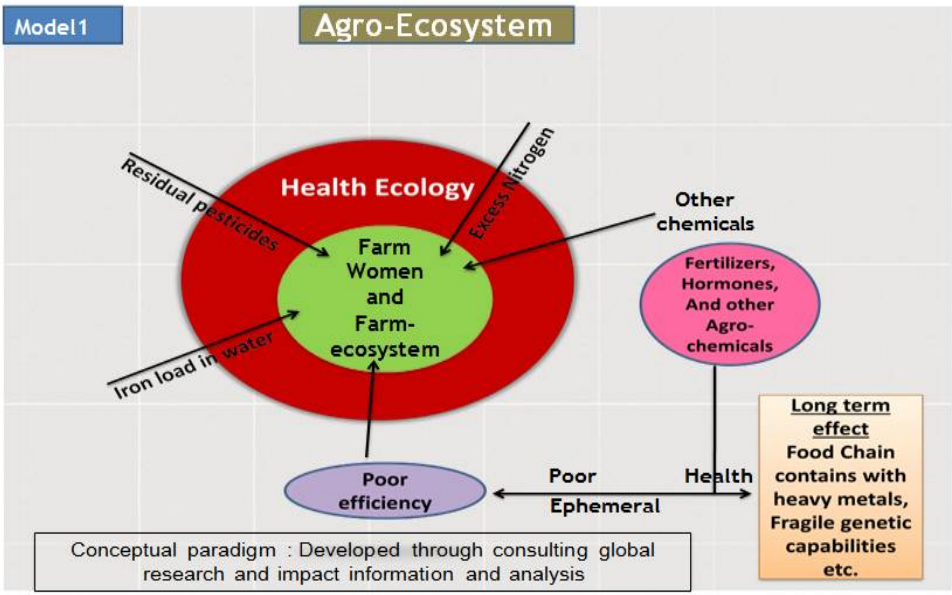

Fig.2: Entry of heavy metals and other gaseous compound into the agro-ecosystem and Farm Women operating at the center

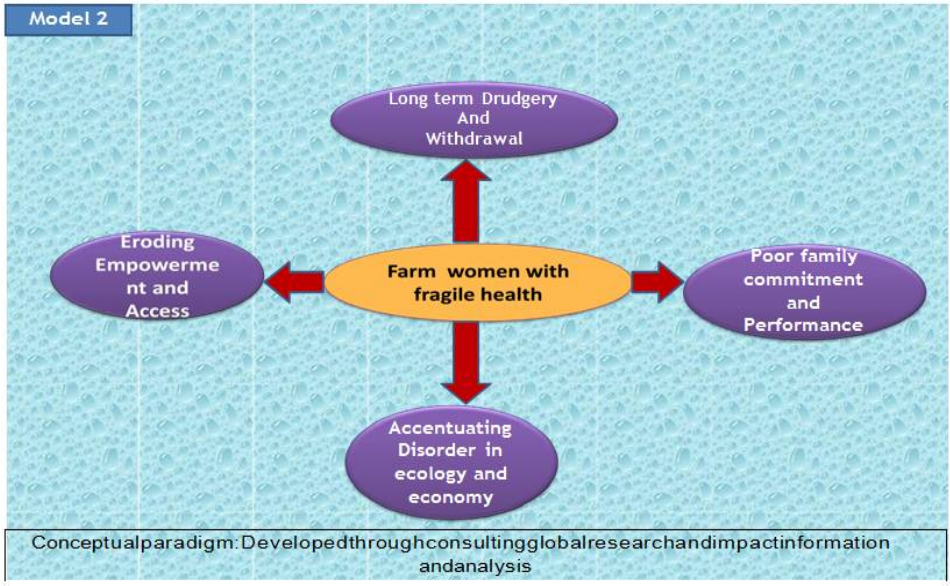

Fig. 2: Impact of broken health due to contaminated farm ecology

2. ECOLOGY

At community level, ecology can be outlined as complex interactions that exist among inter-dependent organisms that cohabitate in the same geographical region and with their environment (Johnson and Strinchcombe, 2007). At individual level, it entails the relationships between that particular individual with varied physical and biological factors. The physical environment along with the biological organisms or biota inhabiting in a particular area builds up an ecosystem. Some typical examples of ecosystems include a farm pond, meadow and rain forest. In a natural environment,an ecosystem follows a chain of processes and events through the days, seasons andyears. The processes include not only the cycle of birth, growth, reproduction and death of biota in that particular ecosystem, but alsothe interactions between species and physical characteristics of the geologicalenvironment. Due to these processesandinteractions, the ecosystem gains a

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noticeable structure and function, and matter and energy are exchanged and cycled through the ecosystem. After a long time, better adapted species exists and come to dominate; entirely new species may change, perhaps in a new or altered ecosystem.

2.1 The ecosystems and the organizations

The base of ecological organization mainly is made up with individual such as a single plant or insect or bird. Ecology is basically the interactions of organisms with their environment. In the case of an individual, it entails the relationships between that individual and various physical (rain, sun, wind, temperature, nutrients, etc.) and biological (other plants, insects, diseases, animals, etc.) factors. The next level of organization is the population. A population ismainly the collection of individuals of the same species within an area. We can see populations of humans, birds, trees, or fish in a pond. Population ecology depicts the interaction of the individuals with each other and also with their environment.

The next, more complex, level of organization is the community. Communities consist of different populations like interacting plants, animals, and microorganisms also within defined geographic region. Interactions among different populations within a community is more common to with populations of the same species in other communities, sometimes, there are genetic differences between members of two different communities.

The next level of organization is the ecosystem. An ecosystem consists of different communities of organisms within a physically defined space. For example, aforest ecosystem consists of a number of animal and plant in the soil, forest floor, and forest canopy, along the river bank and in the stream. A stream bottom community, for example, will have various fungi and bacteria living on dead leaves and animal wastes, protozoa and microscopic invertebrates feeding on these microbes, and

larger invertebrates (worms, crayfish) and vertebrates (turtles, catfish). Each community functions somewhat separately, but is linked to each other through interactions. For example, the stream community much dependent upon leavesproduced inthe surrounding trees falling into the stream, feeding the microbes and other invertebrates.

Terrestrial ecosystems may be grouped into units of similar nature, termed biomes (such as a "deciduous forest," "grassland," "coniferous forest," etc.), or into a geographic unit, termed as landscapes, containing several different types of ecosystems. Aquatic ecosystems are commonly categorized on the basis of the movement of water(eg. streams, river basins) or still water bodies (eg. ponds, lakes, large lakes) and freshness of the water, salty water (oceans), or brackish (estuaries). Landscapes and biomes (and large lakes, river basins, and oceans) are subjected to global threats of pollution (acid deposition, ozone layer depletion, air pollution, greenhouse effect) and human activities(soil erosion, deforestation, indiscriminate pesticides use).

2.2. Pesticide pollution and Ecology

2.2.1 Why pesticides are unique among environmental contaminants

Pesticides released into the environment may have several adverse ecological effects ranging from long-term effects to short-lived changes in the normal functions of an ecosystem. Despite the beneficial results of using pesticides in agriculture and public health, their use also involves some deleterious environmental and public health effects. Pesticides hold a unique position among environmental contaminants because of their high biological toxicity (acute and chronic). Pesticides by definition are toxic chemical agents. A pesticide is usually capable of harming all forms of life (i.e. non-target entities) other than the targeted pest species. On account of this behaviourthen, they can best be described as biocides (capable of killing all forms of life). Although some pesticides are selective in their mode of action, their range of selectivity is only limited to the test animals.

2.2.2 The vast potentials of pesticides distribution and fate in the environment

The term chemo dynamics of pesticides refers to the study of the movement and transformation of pesticides, furthermore their fate in various segments of the environment. The environment can be divided into four major namely; air, water, soil and biota (Fig.2. 1).

The widespread use and disposal of pesticides by farmers, institutions and the general public offer several potential sources of pesticides within the environment. Pesticides once released into the environment might have many alternative fates. Pesticides that are sprayed can move in the direction of the airand may eventuallyend up in otherparts of the environment, such as in soil or water. Pesticides that are applied directly to the soil may be washed off the soil with the flow of runoff water in to nearby surface water bodies or may be leached through the soil to lower soil layers and groundwater (Harrison,1990).

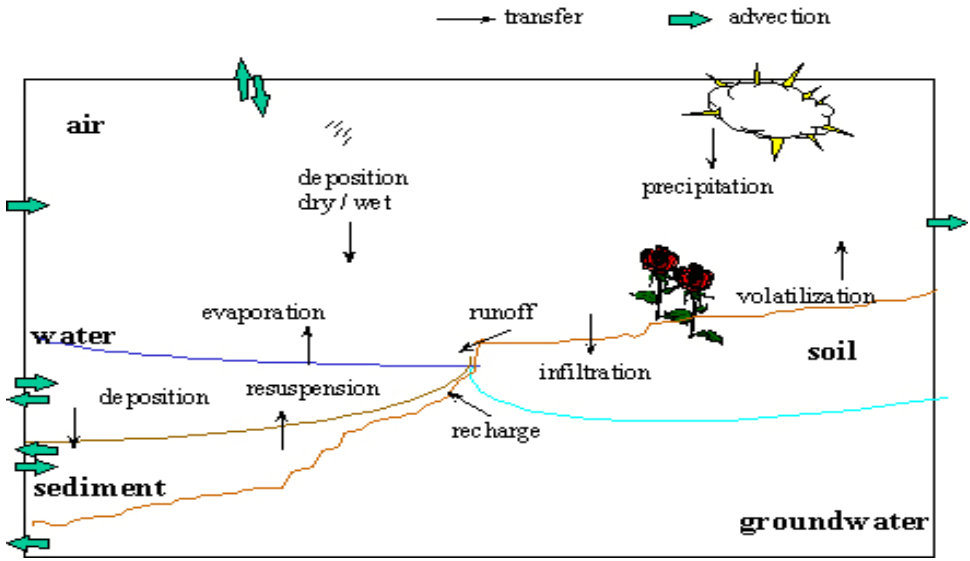

Fig.2.2.3: Distribution of pesticides in different environmental compartments

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2.2.3 Ecological effect of pesticides

The primary objective of using pesticides in the fields and the environment in general is to gain a control of and to combat the crop pests and disease vectors. This has been a deliberate human effort in a search for increasing agricultural yields and improving public health (Helweg, 2003). Pesticides applied to the environment have shown to have long term residual effects while others have shown to have acute fatal effectswhennot properly handled. Organochlorin pesticides forexamplehaveshownTobe persistent in the environment, resulting in contamination of ground water, surface water, food products, air, soil and will have bad impacts on the human being through direct contact. Pesticides exposure to humans are well documented to be the route reason behind some diseases such as cancer, respiratory hazards, skin diseases, endocrine disruption, and reproductive disorders.

Fiftyyears(halfacentury)afterRachelCarson'seloquent warningtotheworld about the devastating effect pesticides on birds and beneficial insects, (non-target population),pesticides continuative apervasiveandinsidiousthreat totheworld's ecosystems.A massive chemicalassaultonour environmentis launchedeachyear.This poisonous barrage aggravates other pressures on our ecosystems such as expanding suburban development and dammed rivers, threatening the survival of many birds, fish, insects, and small aquatic organisms that form the basis of the food web. More generally, pesticides reduce species diversity in the animal kingdom and contribute to population decline in animals and plants by destroying habitats, reducing food supplies and impairing reproduction (Kegley, *et al*,1999).

2.3 Effect of Application of pesticides

2.3.1 Loss of species diversity among the food chains and food webs

Organisms in ecosystems exist in complex inter dependent associations such that lossesof one keystone species as a result of

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pesticides (or other causes) can have so much unpredictable effects. A keystone species holds means that it maintains the organization and structure of entire communities. The loss of a keystone species results in a range of cascading effects that may alter trophic dynamics, other food-web connections and can cause the extinction of other species in the community. Sea otters (*Enhydralutris*) for example, are known to be keystone species in marine ecosystems that limits the density of sea urchins (Mills, *et al*,1993).

A pesticide may eliminate a species essential to the functioning of the entirecommunity, or it may promote the dominance of undesired species or it may simply decrease the number and variety of species present in the community. This may disrupt the dynamics of the food webs in the community by breaking the existing dietary linkages between species. The literature on pest control lists many examplesofnew pest species that have developed when their natural enemies are killed by pesticides. This has created a further dependence on pesticides. Finally, the effects of pesticides on the biodiversity of plants and animals in agricultural landscapes, whether caused directly or indirectly by pesticides, constitute a major adverse environmentalimpact of pesticides.

2.3.2 Effect involving pollinators

Fig. 2.3.2: A butterfly and bee as representative natural pollinating agents for plants.

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Some natural pollinators, such as honeybees and butterflies, are very sensitive to pesticides. Pesticides can kill bees and are strongly implicated in pollinator decline, the loss of species that pollinate plants, as well as through the mechanism of Colony Collapse Disorder(Hackenberg,2007), in which worker bees from a bee hive or Western honeybee colony abruptly disappear. The USDA and USFWS estimate that United States farmers loseatleast$200 million a year from reduced crop pollination as a result of pesticides application to fields eliminate about a fifth of honeybee colonies in the US and harm an additional 15%(Miller,2004).

Since these are important pollinators of both crops and native plants, reduced number of natural pollinators can therefore result into reduced seed and fruit production. This is both an ecological effect as well as economical effect.

2.3.3 Effect on nutrient cycling inecosystem

A large proportional of pesticides used in the environment ultimately reachesthesoil where soil building processes and the cycling of nutrients back into living plants is accomplished.

Pesticides can affect the soil organisms involved in these processes directly or indirectly. Hence, interfering with the natural nutrient cycling in the ecosystem.

Nitrogen fixation, a necessary mechanism for the growth of higher plants, is hindered by pesticides in the soil. The insecticides DDT, methyl parathion, and especially pentachlorophenol have been shown to interfere with legume - rhizobium chemical signalling. Reduction of these symbiotic chemical signalling results in reduced nitrogen fixation and thus reduced crop yields (Rockets, 2007). Root nodule formation in these plants saves the world economy $10 billion in synthetic nitrogen fertilizer every year (Fox, 2007). When the natural nutrient cycling (figure 2.3) in the ecosystem is interfered in any

way by pesticides or other sources of pollution, it will lead to declination of soil fertility and soil productivity.

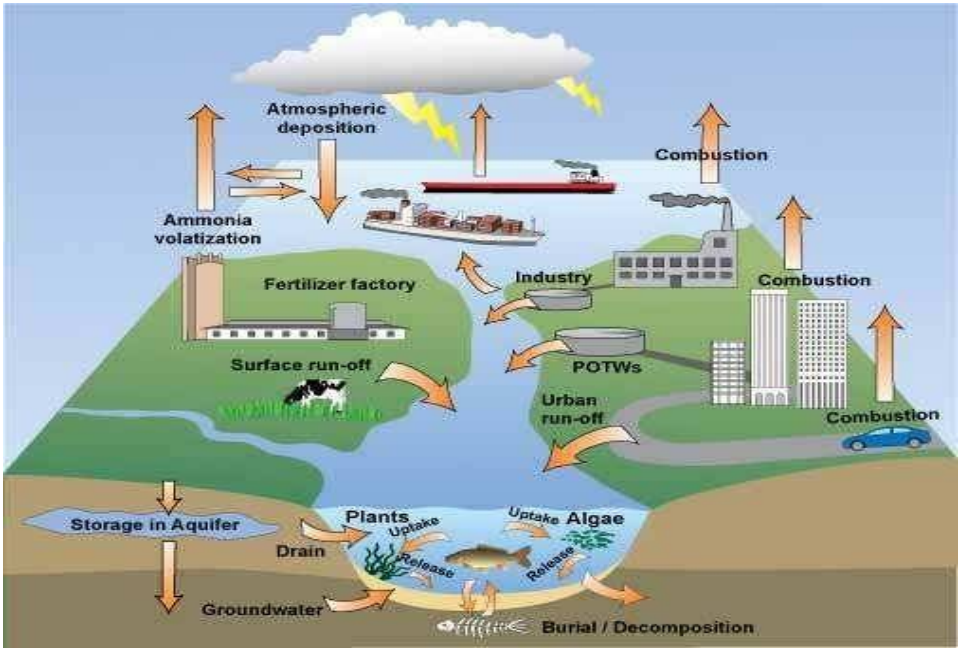

Fig. 2.3.3: Nutrient cycling in ecosystem

2.3.4 Effect on soil erosion, structure andfertility

Many of the chemicals used in pesticides are persistent soil contaminants, whose impact may endure for decades and adversely affect soil conservation. The use of pesticides decreases the general biodiversity in the soil. Not using the chemicals results in higher soil quality (Johnson, 1986), with the additional effect that more organic matter in the soil allows for higher water retention. This helps increase yields for farms in drought years, when organic farms have had yields 20-40% higher than their conventionalones.A smaller content of organic matter in the soil increases the amount of pesticide that will leave the area of application, because organic matter binds to and helps break down pesticides (Lotter*, et al*,2003).

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Herbicides for example can reduce vegetative cover of the ground, thus promoting soil erosion via runoff and wind. Soil erosion deforms the soil structure and therefore creates an imbalance in soil fertility. A bare land with poor soil structure and poor soil fertility cannot support the growth of plants on it. Ecologically this land cannot support other forms of life in it hence may result in the collapse of the particular ecosystem.

2.3.5 Effect on water quality

Pesticides applied in the environment can find their way into water bodies either fromthe air or by runoff or by percolation to ground water. There are four major routes through which pesticides can reach to the water bodies either it may drift outside of the intended area when it is sprayed, it may percolate or leach through the soil, or it may be carried to the water as runoff, or it may be spilled, for example accidentallyor through negligence. They may also be carried to water by eroding soil. Factors that have an effect on the pesticide's ability to contaminate water include itswater solubility,the distance roman applicationsitetoawaterbody,weather,soiltype,presence of a growing crop,andthe method used to apply the chemical. Once pesticides enter into the water bodies they have a potential to cause harmful effects on human health, aquatic organisms and may cause disruptions of the aquatic ecosystems. This may result into a loss in fish production in streams and large water bodies especially where fishing is one among the major economic activities of a particular community.

In the United States for example, pesticides were found to pollute every stream and over 90% of wells sampled in a study by the US Geological Survey(Gillion,*etal*,2007). Pesticide residueshave also been found in rain and groundwater. Studies by the UK government showed that pesticide concentrations exceeded those are allowed for drinking water in some samples of river water andground water(Bingham,2007).

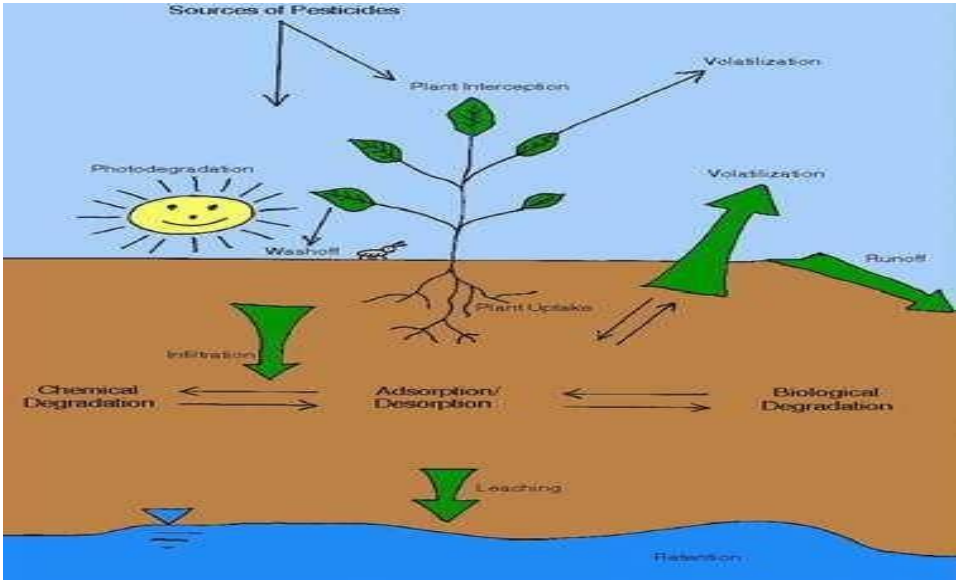

Fig. 2.3.5: Pesticides' pathways in contaminating water bodies (Heather, *et al*, 1997)

2.3.6 Effect on birds

Pesticides have had some of their most striking effects on birds;particularly those are occupying the higher tropiclevels of food chains, such as bald eagles, hawks, and owls. These birds are often rare, endangered, and susceptible to pesticide residues such as those occurring from the bio concentration of organochlorin insecticidesthrough terrestrial food chains. Pesticides may kill grain- and plant-feeding birds, and the elimination of many rare species of ducks and geese has been reported. Populations ofinsect-eating birds such as partridges, grouse, and pheasants have decreased due to the loss of their insect food in agricultural fields because of the use of insecticides. The loss of even afew individuals from rare, endangered or threatened species pushes the entire species close to extinction. Some pertinent examples related to birds 'kills as a resultofpesticides embody the insecticides diazinonandcarbofuranwhich are well document as causing bird kills in various parts of the

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world(Kegley*etal*,1999).Organochlorininsecticide such as DDT is also well known because of continued impairing avian reproduction even after years of ban. Most bird kills go unregistered, with reported kills representing only a small fraction of actual bird mortality due to pesticides.

Birds exposed to sub-lethal doses of pesticides are also affected with chronic hazards that have an effect on their behaviour, reproduction, and nervous system also. Weight loss, increased susceptibility to predation, decreased disease resistance, lack of interest in matingand defending territory, and abandoning of nestlings have observed as the side effects of pesticide exposure.

Fig.: A bird that died as a result of pesticides use (U.S.EPA)

2.3.7 Effect on fish and other aquatic organisms

An important environmental impact has been the widespread mortality of fish and marine invertebrates because of the contamination of aquatic systems by pesticides. This has resulted from the agricultural contamination of waterways through fallout, drainage, or runoff erosion, and from the discharge of industrial effluents containing pesticides into waterways. Historically, most of the fish in Europe's Rhine River were killed by the discharge of

pesticides, and at one time fish populations in the Great Lakes in USA became too much low because of pesticide contamination. In addition, number of organisms that provide food for fish are heavily susceptible to pesticides, so the indirect effects of pesticides on the fish food supply may have an even greater effect on fish populations. Some pesticides, such as pyrethroidinsecticides, are extremely harmful to most of the aquatic organisms. It is evident that pesticides cause major losses in global fish production. Moreover, recent laboratory studies of endosulfanand fenitrothioninthe tilapia species from Lake Victoria in Tanzania indicated a highcapability of the species to absorb the two pesticides from water with rapid distribution in the organs each with a bioaccumulation factor of 33 and 346 L/ kg fresh weight respectively (Henry,2003).

Multiple pesticides contamination are very common in water and sediments, frequently at

Concentrations,surpassing the lethal limits for several species of zooplankton, small species of animals eaten by fish.Duetothe significant high water solubility of the insecticides diazinonandchlorpyrifosand the herbicides simazine, diron, and EPTC are found mostly in the water bodies and have been associated with fish killing anddeclination of population of zooplankton in aquatic environment.

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Fig. 2.3.7: Spraying an aquatic herbicide

Fig.2.3.8: Kihansi spray toads from Kihansi Gorge in Tanzania

2.3.8 Effect on frogs and other aquaticamphibians

Atrazine being one of the world`s most used pesticide has recently reported by laboratory studies to have a effect on changing male frogs (African clawed frog; *Xenopuslaevis*).Adult frogs exposed to Atrazine turn female one in ten (10%).

These male frogs are missing testosterone and all things controlled by testosterone including sperm production. Thus, their fertility is as low as 10 percent when treated in isolation, but when treated with normal males, they stand a zero chance of reproducing. Although ten per cent (10%) of these mutant females can successful mate with male frogs, their offspringsareall male as they are genetically male frogs.The ultimate impact of these are that the sex ratios of frogs is badly skewed and thisisvery dangerous for the survival of that species (Hayes*etal*,2010). Kihansispray to adsisoneamongthe world`s rarest amphibian species that was close to extinction from their natural environment in Tanzania. The species was first discovered in 1996 during an environment impact study for a large new hydroelectric dam in Udzungwamountains in Southern Tanzania..Torestorethis rare species of toads, a colony of them was carried to Bronx zoo and Toledo zoo in USA where they were reared and reproduced in laboratories for tenyears.

2.4 Disruption of the natural balance between pest and predator insects due to pesticides

Broad spectrum pesticides such as organochlorin, organophosphorusand carbamateinsecticides destroy both pest and beneficial organisms indiscriminately, thus disconcerting the natural balance between pests and predator insects. Beneficial organisms serve various valuable functions in an agricultural ecosystem including pollination, soil aeration, nutrient cycling, and control of natural pest through pest-predator relationship. Application of insecticides indiscriminately kills both pests andbeneficialOrganisms. Pest populations often recover too rapidly because of their lager numbers and capability to develop

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resistance,however, beneficial organisms do not, leading to a resurgence of the target pest as well as secondary pests that reproduce rapidly without the checking of natural predator, their numbers. This prompts an escalation in the use of more and more pesticides by the farmers in an attempt to manage the pests and to boost their harvest.

Fig. 2.4: Aerial spraying of pesticides onto the crops using an aircraft

2.4.1 Pesticides cause pest rebound and secondary pest outbreaks

Non-target organisms, organisms that the pesticides are not meant to be killed, may be severely harmed due to the indiscriminate use of pesticides. In some cases, where a pest insect has also some controls from the beneficial predators or parasites, insecticide application can kill or damage both the pest and beneficial populations.Astudy comparing biological pest control and use of pyrethroid insecticide for diamondback moths (DBM), which is a major cabbage family insect pest, showed that, the insecticide application created a rebounded pest population due to loss of

insect predators, whereas the biological control did not show the same effect (Muckenfuss, *et al* 1990). Likewise, pesticides sprayed in an effort to control adult mosquitoes,itmay temporarily depress mosquito populations,butthey may result in a larger population in the long run by damaging the natural controlling factors. This phenomenon, wherein the population of a pest species rebounds to equal or larger numbers than it had before the use ofpesticide, is termed as pest resurgence and can be linked to elimination of predators and other natural enemies of the particular pest(Daly,*etat*,1998)

The loss of predator species may also lead to a related phenomenon called secondary pest outbreaks, an increase in problems from species which were not originally very damaging pests due to loss of their predators or parasites (Daly, *et at*, 1998). An estimated one-third of the 300 most damaging insects in the United States wereoriginally secondary pests and solely became a serious problem after the use of pesticides (Miller, 2004). In both pest resurgence and the secondary pest outbreaks, sometimes, thenatural enemies have found more susceptible to the pesticides than the pests themselves, in some cases causing the pest population to be higher than it was before the application of pesticides.

2.4.2 Pest resistance maybecausedbyuseofpesticides

Pests may evolve to be resistant to the pesticides as a result of continued use of pesticides in a particular environment. Many pests may initially be very susceptible to pesticides, but after some days, they will be with slight variations in their genetic make- up and become resistant and therefore survive for reproduction. Through the

Processof natural selection, the pests may eventually become very resistant to thepesticide. Pest resistance to a pesticide is commonly managed through the rotation of pesticide, which involves alternating among pesticide classes with different modes of action to delay the

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Onset of or to mitigate existing pest resistance.. Another type is Tank mixing pesticides, which is the combination of two or more pesticides with different modes of action in order to improve individual pesticide application resulting and delay the onset of or mitigate existing pest resistance.

2.5 Pesticides and food-chain: Effect on humanhealth

Pesticides may enter into the human body either through inhalation of aerosols, dust and vaporthat contain pesticides; or through oral exposure by consuming contaminated food and water; and through dermal exposure by direct contact of pesticides with skin (Sacramento, 2008). Pesticides sometimes are sprayed onto food, especially on fruits and vegetables, they remain intosoilsandleachedintothegroundwaterwhichcanendupin drinkingwater,andsprayingof pesticide can drift and pollute theair.

The impacts of pesticides on human health are more harmful based on the toxicity of the chemical and the length and magnitude of exposure (Lorenz, 2009). Farm workers and their families experience the widest exposure to agricultural pesticides through direct contact with the chemicals in the field. But every human contains a percentage of pesticides has found in fat samples in their body. Children are most susceptible and sensitive to pesticides due to their small size and underdevelopment. The chemicals can bioaccumulation the body over time. Exposuretopesticides range, from mild skin irritation to birth defects, tumours, genetic changes, blood and nerve disorders, endocrine disruption, and even coma or death etc. (Miller,2004).

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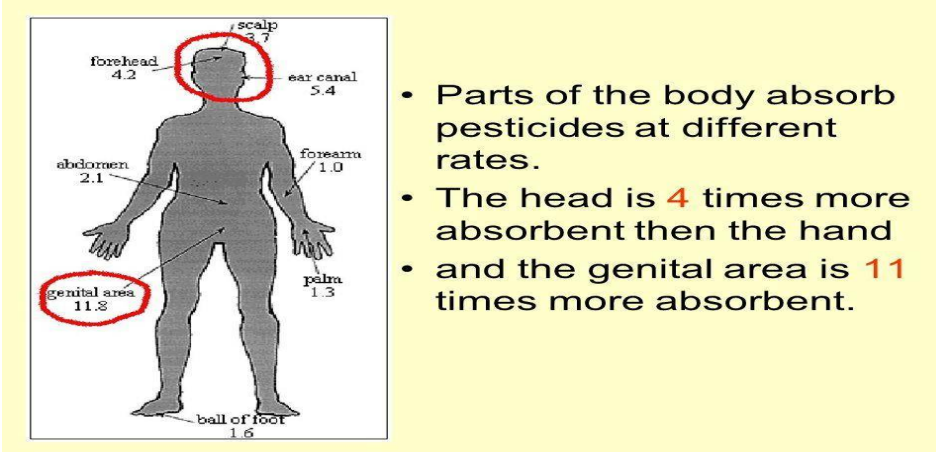

Fig.2.5: Body parts mostly prone to pesticide absorption: Source: Google image

2.5.1 Death of farmers due to injudicious pesticide use : An untoldstory

According to a PAN India report, pesticides have become a major source of deaths, and debilitation across India, either, by means of self-poisoning, deliberate or accidental poisoning. Within the ease of reach of the depressed and stressed peoples, pesticides have become a causal factor in the loss of number of lives, of farmers, farm women, girls, boys and children. And continuous exposure to the pernicious pesticides during spraying in the field is another harm of these killer products that has not been received adequate attention from policy and decision makers and medical professionals. However, periodically, India also faces a major outbreak of pesticide exposure-led deaths. Way back to 2002, such deaths of farmers happened in Warangal. Similar deaths were noticed in Yavatmal district of Maharashtra. There more than 40 deaths have occurred and more than 1,000 farmers and farm workers have been hospitalised between September and October months of 2017. According to the reports, farmers who have been spraying pesticides in cotton fields have developed health problems viz. nausea, vomiting, irritation or eye burns, etc. and were taken to hospitals for treatment. Inhalational poisoning cases reach their peak mainly during August and September. An analysis

revealed that between July 6th and October 11th, 2017, 450 cases of Inhalational poisonings due to exposure to the pesticides arereported.

According to a junior doctor in the hospital in that region, the visual symptoms were mainly nausea, vomiting, head ache, sweating, restlessness, loose motions, fasciculation (i.e. Muscle twitch), respiratory distress, pupil constriction, shivering, etc

In spite of this widespread, alarming incidence of pesticide poisoning, there is still no standard protocol for best, appropriate and timely treatment. India-wide, in the district hospitals, where pesticide usage is rampant, injudicious are inadequately equipped in terms of specialized toxicology services, beds, antidote stocks and other necessary equipment andmedicines.

We should know that, all pesticide poisonings are considered as–Medico- legal cases–(MLCs). It is instructed that, if the procedures of MLC are followed entirely, every _inhalational poisoning should have to be investigated by the police.

Best treatment for poisoning mainly depends on the availability of appropriate antidote in adequate quantity and at the appropriate time as soon as, after poisoning. Depending on the poison, delayed use or unavailability of an antidote may lead to severe problems and in some cases it may lead to death even. In some poison cases antidote should be administered within 30 minutes of poison ingestion. There is no rational and scientific medical treatment for the affected farmers. Farmers, who have chronic, persistent health problems due to pesticides exposure and are in need of urgent medical attention, are being ignored. It has been noted that farmers / farm workers generally use several different types of spraying equipment's. It includes hand-operated pumps, battery-linked motor sprayers to petrol-fuelled motor sprayers. Faulty sprayers are mainly blamed. It is a reality that farmers who handle i.e. mix and spray pesticides, do not use personalprotectiveequipment(PPE).TheInsecticidesruleshaveclearlyput forth the requiredprotectiveclothing including respiratory devices to be used while working with pesticides (Rules 39 and 40). Awareness on the

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use of pesticides, precautionary measures, safety aspects, etc., should be given properly. As a result, they have vulnerability to spillage, exposure, misuse, etc.. While spraying, workers can be exposed to pesticides variously; through direct exposure to spillage, spray drift though inhalation and/ or contact via skin. Continuous absorption of pesticides through the skin of the worker, results in higher health risk, often workers get drenched under the motor-operated sprayers, when their concentration is on avoiding snake bites, wading through the thick cotton crop foliage and in other incidental conditions. Pesticide poisoning should be declared as a national tragedy and should be obviously enlisted in the disaster list maintained by the National Disaster Management Authority. A standard medical treatment protocol should be developed at the national level.

In India, pesticides are regulated by various government agencies. The Central Agriculture Ministry mainly regulates the manufacture, sales, transport and distribution, export-import and use of pesticides following the Insecticides Act, 1968 and the Insecticides Rules 1971. The Central Insecticides Board is solely responsible for advising the Central and State governments on technical issues related to manufacture, use and safety of pesticides.

Most importantly, harmful pesticides constitute the core causethat lies at centre of these unfortunate series of human loss, along with apathy, disdain, profiteering motives and corruption. Agro-chemicals, with toxic contents, need to be restricted, and ultimatelybanned.

2.5.2 Classification of pesticides in respect oftarget-organisms:

Insecticides	Kill insects and other arthropods	Aldicarb
Fungicides	Kill fungi (including blights, mildews, molds,	Azoxystrobin
Bactericides	Kill bacteria or acts against bacteria	Copper complexes
Herbicides	Kill weeds and other plants that grow where	Atrazine
they are not wanted		
Acaricides	Kill mites that feed on plants and animals	Bifenazate
Rodenticides	Control mice and other rodents	Warfarin
Algaecides	Control or kill growth of algae	Copper sulphate
Larvicides	Inhibits growth of larvae	Methoprene
Repellents	Repel pests by its taste or smell	Methiocarb

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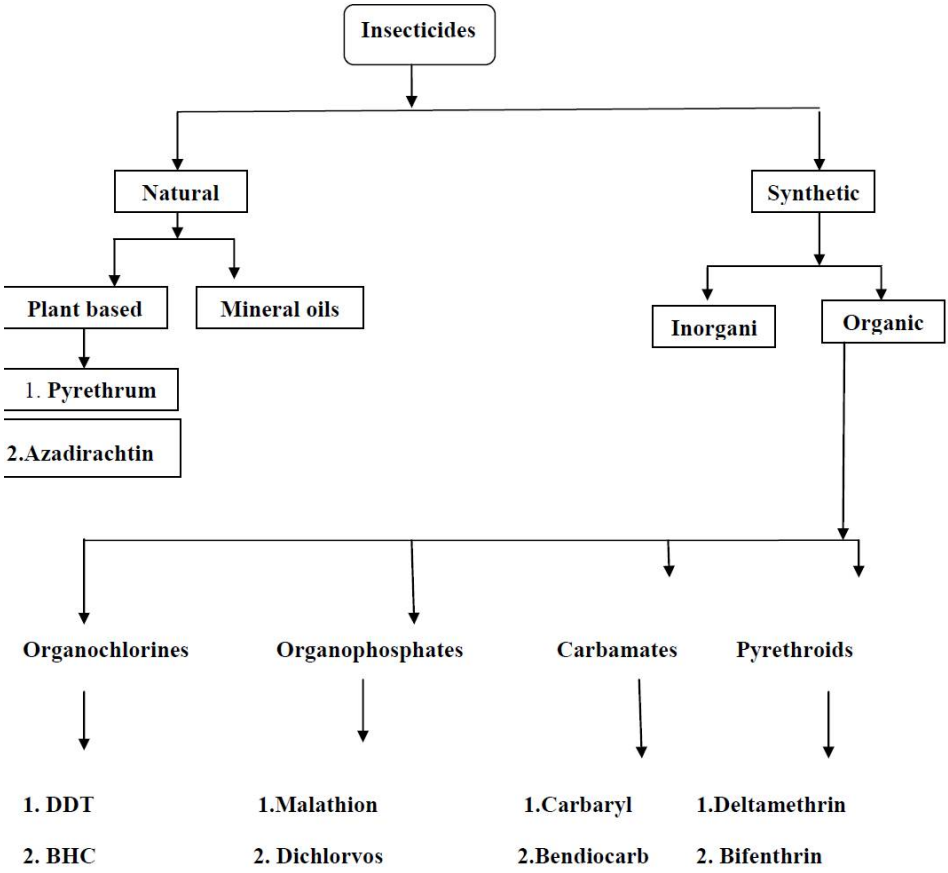
Desiccants	Act on plants by drying their tissues Boric acid	
Ovicides	Inhibits the growth of eggs of insects and mites	Benzoxazin
Virucides	Acts against viruses	Scytovirin



2.5.4 Classification of insecticides

Here, a list of crops which are mainly grown in the present area of study and the recommended pesticides to combat the pests are given below. It will help to make a comparison that whether the recommended pesticides are in use by the farm workers or not. Because irrational, injudicious application of pesticides may result in ecological imbalances and in turn it may affect the human health through the way of bio- magnification.

Acephate

Crops	**Pests**
Cotton	Jassids
	Boll Worms
Safflower	**Aphids**
Rice	Stem Borer, Leaf
	Folder,Plant
	Hoppers,Green Leaf
	Hopper

ALUMINUM PHOSPHIDE 56% 3 g tab, 10g pouch

Name of Commodity	**Name of the pests**
Stored Whole	Rice Weevil (S.O)
Cereals and	Lesser Grain Borer,
Seed	Khapra Beetle (T.g),
Grains	Rust Red Flour
Millet	Beetle, Saw
Pulses	Toothed Grain
Dry Fruits, Nuts	Beetle , Caddlle
Spices & Oil	Beetle, Drug Store
Seeds	Beetle , Cigarette
	Beetle , Pulse Beetle
Mild Products :	Long Headed Floor
Deoiled Cakes,	Beetle, Coffee

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Rice Bran Flour,	Borer, Dried Fruit
Grain Animal &	Beetle, Flat Grain
Poultry Food	Beetle,
Split Pulses	
(Dal) & other	
Processed Food	

Azadirachtin 0.15% W/W Min. Neem Seed Kernel Based E.C.	
Crops	**Pests**
Cotton	White fly
Rice	Bollworm
	Thrips Stem borer
	Brown Plant hopper
	Leaf folder

Buprofezin 25% SC	
Crops	**Pests**
Cotton	White Fly Aphids
	Jassids
	Thrips
Chilli	Yellow Mite
Rice	BPH,
	GLH,WBPH

Carbaryl 5% D.P.

Crops	**Pests**
Paddy	Leaf roller/folder
Cotton	Brown plant hopper

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Sorghum	Spotted bollworm
Bhindi	American bollworm
	Pink Bollworm
	Jassids
	Aphids
	Earhead midge
	Jassid

Carbofuran 3% CG	
Crops	**Pests**
Barley	Aphid
	Jassid
	Cyst nematode
Bajra	Shoot fly
Sorghum	Shoot fly
	Stem borer
Jute	Nematodes
Groundnut	Pod borer
	White grub
French bean	White grub
Potato	Aphid
	Jassids
Tomato	White fly
Apple	Woolly aphid
Citrus	Nematode
	Leaf miner
Maize	Stem borer
	Shoot fly
Paddy	Thrips
	Brown plant hopper
	Gall midge, Stem
	borer, G LH,
	Hispa
Mustard	Nematodes

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Soybean	Mustard leaf miner
	White fly
Sugarcane	Root knot nematode
	Top borer
Bhindi	Jassids
Chillies	Aphid
Cabbage	**Thrips**
Wheat	Nematode
Brinjal	Ear cockle nematode
	Cereal cyst nematode
	Root knot nematode
	Reniform nematode

Cartap Hydrochloride 4% Granules	
Crops	**Pests**
Rice	Stem borer
	Leaf folder
	Whorl Maggot

Cartap Hydrochloride 50% SP	
Crops	**Pests**
Rice	Stem borer
	Leaf folder

Chlorfenapyr 10% SC	
Crops	**Pests**
Cabbage	Diamond back moth
	(Plutella xylostella)
Chilli	Mites
	(Polyphagotarsonemus

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	latus)

Chlorpyrifos 10% G	
Crops	**Pests**
Rice	Stem borer
	Leaf roller
	Gall midge

Chlorpyrifos 20% EC	
Crops	**Pests**
Paddy	Hispa
	Leaf roller
	Gall midge
	Stem borer
	Whorl maggot
Beans	Pod borer
Gram	Black bug
	Cut worm
Sugarcane	Black bug
	Early shoot & stalk borer
	Pyrilla
Ground nut	Aphid
	Root grub
Mustard	Aphid
Brinjal	

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Cabbage	Shoot & fruit borer
Onion	Diamond back moth
	Root grub

Cypermethrin 0.25% DP	
Crops	**Pests**
Brinjal	**Fruit & shoot borer**

Cypermethrin 10% EC	
Crops	**Pests**
Cotton	Spotted bollworm
	American bollworm
	Pink bollworm
Cabbage	Diamond black
Okra	moth
	Fruit borer
Brinjal	Fruit & shoot borer
Sugarcane	Early shoot borer
Wheat	Shoot fly
Sunflower	
	Bihar hairy
	caterpillar

Deltamethrin 1.8% EC	
Crops	**Pests**
Cotton	Bollworms
	sucking insects
Rice	Stem borer, Leaf folder
Wheat &	Rice weevil

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Rice	Leaser grain borer
(Grain &	Khapra beetle
seed in	Red flour beetle
stacks)	Saw toothed grain beetle
	Rice moth
	Almond moth

Dicofol 18.5% EC	
Crops	**Pests**
Tea	Red spider mite
	Scarlet mite
	Pink mite
	Purple mite
	Yellow mite
Okra	Red Spider mite
Citrus	Red Spider mite
Litchi	Red Spider mite
Cotton	Red Spider mite,
	Yellow mite
Brinjal	Red Spider mite
Bottle &	**Red Spider mite**
Bitter gourd	

Dimethoate 30% EC	
Crops	**Pests**
Bajra	Milky weed bug
Maize	Stem borer
	Shoot fly
Sorghum	Midge
	Pod borer
Red gram	Thrips

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	Aphid
Cotton	Grey weevil
	Jassids
	Thrips
Castor	Jassids
	Mites
	Semi looper
	White flies
Groundnut	Leaf minor
Mustard	**Aphid**
Safflower	Aphid
Bhindi	Aphid
	Leaf hopper
Brinjal	Jassid
Cabbage &	Shoot borer
Cauliflower	Aphid
	Painted bug
	Mustard aphid
Chillies	Mite
Onion	Thrips
Potato	Thrips
Tomato	Aphids
Apple	White fly
Apricot	Stem borer
Banana	Aphid
	Aphid
	Lace wing bug

Fenvalerate 20% EC	
Crops	**Pests**
Cauliflower	Diamond back moth
	American boll worm
	Aphids

	Jassids
Cotton	Boll worm Aphids Jassids Thrips
Brinjal	Shoot & fruit borer Aphids

Fenvalerate 0.4% DP	
Crops	**Pests**
Cotton	Spotted Bollworm **Pink Bollworm**

Fipronil 5% SC	
Crops	**Pests**
Rice	Stem borer Brown plant hopper Green leaf hopper Rice leaf hopper Rice gall midge Whorl maggot White backed plant **hopper**
Cabbage Chillies	Diamond back moth Thrips, Aphids, fruit borers
Sugarcane	Early shoot borer & root borer

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Fipronil 80%WG	
Crops	**Pests**
Rice	Stem borer
	Leaf folder

Phorate 10% CG	
Crops	**Pests**
Bajra	Shoot fly
	White grub
Barley	Aphid
Maize	Shoot fly
Paddy	Stem borer
	Gall fly
	Hispa
	Leaf hopper
	Plant hopper
	Stem borer
Sorghum	Shoot fly
	Aphids
	White grub
Wheat	Shoot fly
Black gram	Stem fly
	White fly
Green gram	Stem fly
	Jassids

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Arhar	Jassids Stem fly
Sugarcane	Top borer White grub
Groundnut	Aphid
	Leaf minor White grub
Mustard	Mustard aphid Painted bug
Sesame	Jassids White fly
Brinjal	Aphid Jassids Lace wing bug Red spider mite Thrips
Potato Tomato	Aphid White fly
Cauliflower Chilli	Aphid Aphid Mite Thrips

Profenofos 50% EC	
Crops	**Pests**
Tea	Red spider mite, Pink mite, Tea mosquito bug Looper caterpillar **Thrips, Jassid**
Cotton	Bollworm Jassids Aphids Thrips
	Whiteflies

Thiacloprid 21.7% SC	
Crops	**Pests**
Cotton	Aphid, Thrips, **Jassid** **White fly**
Paddy	**Stemborer**
Chilli	**Thrips**

Thiamethoxam 25% WG	
Crops	**Pests**

Rice	Stem borer Gall midge Leaf folder BPH WBPH GLH **Thrips**
Cotton	Jassid Aphid Thrips **White flies**
Wheat	**Aphid**
Mustard	**Aphid**
Tomato	**Whitefly**
Brinjal	**Whitefly**
Tea	**Mosquito bug**
Mango	**Hoppers**
Potato	Aphids
foliar application Soil drench	**Aphids**
Citrus	**Psylla**

*Source:*GOI / MOA / DAC/ Dy of plan protection,quarantine and storage central insecticide board and registration committee.

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2.6 What is Occupational health?

Occupational health is a multidisciplinary activity aimed at:

- The protection and promotion of the health of workers by preventing and controlling occupational diseases and accidents and by eliminating occupational factors and conditions hazardous to health and safety atwork;
- The development and promotion of healthy and safe work, work environments and workorganizations;
- The enhancement of the physical, mental and social well-being of workers and support for the development and maintenance of their working capacity, as well as professional and social development atwork;enabling workers to conduct socially and economically productive lives and to contribute positively to sustainabledevelopment.

2.6.1 Occupational Health hazards and its types

A hazard is something that can cause harm if not controlled. It is an unplanned, unforeseen or uncontrolled event- generally one which has unhappy consequences. It also refers to the potential risks to health and safety for those who work outside and inside the home (Nag PK, Sebastian NC, Malvankar MG;1980). As farmers involve both in household and farm activities, they are more prone to this. They are exposed both outdoor and indoor environment. The different types of hazards are givenbelow.

2.6.2 Different types of pesticides and their effect

Pesticides are a group of chemicals used to destroy various kinds of pests including insects, rodents, weeds, snails, fungi, etc. The degree of toxicity of different pesticides varies greatly from deadly poisons to slightly harmful pesticides. Exposure to pesticides occurs in industries where the pesticides are manufactured and formulated, and during their application in agriculture or in public health. Pesticidesarealso used at home.

They are classified into several groups, according to their chemical composition. The most frequently used nowadays are organophosphates, carbamates and thio-carbamates, pyrethroids and

organochlorinepesticides. Other groups include lead arsenate, organic mercury, thallium compounds, coumarin, bromomethane, cresols, phenols, nicotine, zinc phosphide, etc.

Pesticides are absorbed through the lungs, the gastrointestinal tract and sometimes through the intact skin and eyes (organophosphates).

Organochlorine: Examples are DDT, aldrin, dieldrin, toxafene and gammaxane. They are slightly to moderately toxic, and are not biodegradable in the environment or in the human body. They accumulate in the environment and for this reason have been banned in many countries.

Acute exposure causes irritability of the central nervous system. Symptoms appear after 30 minutes to several hours (usually not more than 12 hours). They include headache, dizziness, nausea, abdominal pain, irritability, convulsions, coma, pyrexia, tachycardia, shallow respiration and death.

If the patient survives, convulsions stop within 24 hours but weakness, headaches and anorexia may continue for two weeks or more. Chronic exposure may cause gastrointestinal, liver, kidney or nervous affection.

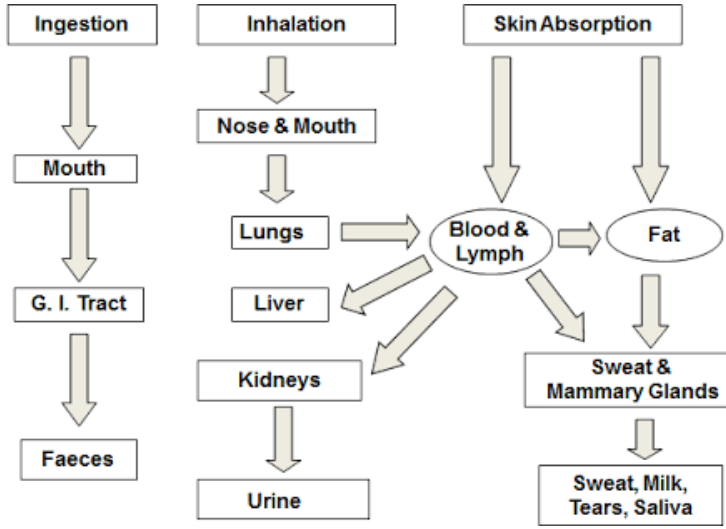

Fig. Routes of chemical absorption Source: Google image

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2.6.3 Organophosphates

These include parathion, methyl parathion, malathion and tetraethyl pyrophosphate. Organophosphates include some extremely toxic and some slightly toxic compounds. They do not accumulate in the environment or in the human body. They are biodegradable within a few weeks.

Organophosphates cause the inhibition of the choline-esterase enzyme resulting in accumulation of acetyl choline in the body. Symptoms and signs include dyspnoea, sweating, nausea, abdominal colic, diarrhoea, constriction of the pupils, muscle twitches, irritability, anxiety, headaches, ataxia, convulsions, respiratory and circulatory failure, coma and death. In severe cases symptoms appear within minutes and in slight cases after hours but never exceeding 24 hours. Death may occur within hours in severe cases. If recovery occurs it takes a few weeks for the patient to return to normal. Blood examination reveals reduction of choline-esterase activity; the test is used in periodic medical examinations.

2.6.4 Carbamates and thio-carbamates

These are moderately toxic (carbaryl) and cause toxicity through the same mechanism as organophosphates except that inhibition of choline-esterase enzyme is temporary and recovers spontaneously within 48 hours if death does notoccur.

Pyrethroids: These are synthetic pesticides of low toxicity used in homes. Toxic symptoms take the form of sensitivityreactions.

2.7 Different types of chemicals used in agriculture and their effect on farmers'health

About 100 000 different chemical products are in use in modern environments and number is growing. Exposure varies widely. Health effects include damage to the central nervous system and liver (caused by exposure to solvents), pesticides poisoning, dermal and respiratory allergies, dermatomes, cancers and reproductive disorders. Farmers exposed to toluene have reported a greater frequency of menstrual dysfunction including dysmenorrhea, irregular cycles and spontaneous abortions. Toxic corrosive, allergenic and carcinogenic chemicals act by

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local action, inhalation and ingestion on exposure to concentrations beyond the threshold limit value(TLV).

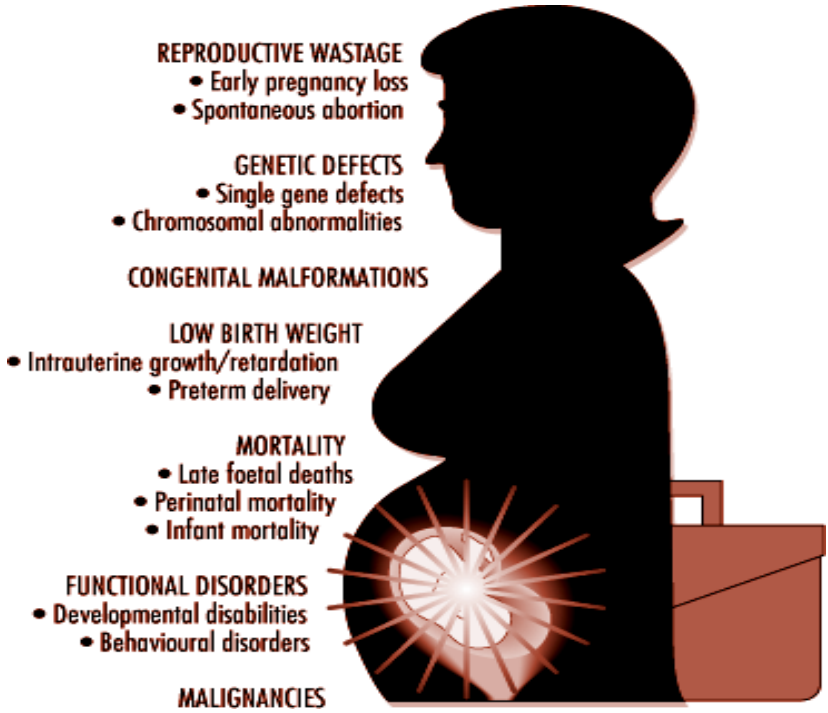

Fig. 2.7: Perceived effect of agro-chemicals on the health of women.(Source. Google image)

Farmersareexposedtothousandsofchemicals,someofthemoftencausesh ealth problems.These chemicals will be classified based on their physical state, chemical composition or physiologicalactions.

a) Gases and vapors: These can be classified according to their physiological action into: asphyxiates irritant gases.

>Asphyxiates-Can causes asphyxia either by replacing oxygen or by some other mechanism. They are classified into: simple asphyxiates and chemical asphyxiates. Simple asphyxiates: replace oxygen, e.g. nitrogen, methane, hydrogen and carbon dioxide.

Nitrogen: a simple asphyxiate used in the fertilizer industry.

Methane (marsh gas): results from decomposition of organic matter and is present in marshes, sewers. It is a simple asphyxiate, inflammable and lighter than air.

Chemical asphyxiates: interfere through some chemical action with the respiratory function of the blood, tissue cells or respiratory centre, e.g. carbon monoxide (CO), hydrogen sulphide.

>Irritant gases - These can cause irritation or inflammation of the mucous membranes with which they come into contact. This property depends on their degree of solubility in water.

Highly soluble gases, like ammonia, affect the upper respiratory passages. Less soluble gases like chlorine and sulphur dioxide affect both the upper respiratory passages and the lung tissues. Gases which are even less soluble, like nitrogen oxides and phosgene, act essentially on the lungs and in this case the irritant affect may be delayed for hours.

Nitrogen oxides (NO_x): nitrous oxide (N_2O) is an anaesthetic and in the absence of O_2 is a simple asphyxiate. Nitrogen oxides are a mixture of NO_2 and N_2O_4 and are brown in colour. Exposure occurs inchemical laboratories, in the explosive industry, in the manufacture of nitric or sulphuric acids, fertilizer industry and on slow combustion of nitrogen-containing materials. It is present in welding operations and in soils.

Due to their poor water solubility, nitrogen oxides can be inhaled in high concentration without sufficient warning irritation but it has a severe irritant effect on the lung tissue. Symptoms may be delayed 2–20 hours, after which fatal pulmonary oedema may occur. Therefore, regardless of the condition of the patient when first seen, he/she should be put under close observation, preferably in hospital, for at least 24 hours.

Sulphur dioxide (SO_2): one of the most common air pollutants. It results from the combustion of fuels containing sulphur. It is used in the production of sulphuric acid, in the preservation of fruits, in sugar industry. Exposure causes irritation of the eyes and upper respiratory passages. High

concentrations may cause oedema of the larynx, pulmonary oedema, pneumonia and even death.

Ammonia (NH_3): a common upper airway tract irritant. It is a highly soluble alkaline gas that is widely used in the manufacture of fertilizers. It attacks the skin, the conjunctiva and the mucous membranes of the upper respiratory tract. Oedema of the larynx and pulmonary oedema can occur with exposure to high concentrations and can causedeath.

b) Metals:

Poisoning with metals usually takes the chronic form and results from the absorption of small amounts over long periods of time. Acute poisoning may result from accidental (or suicidal) intake of large doses of some of the more toxic compounds (like arsenicals). Metals and their compounds gain access into the body by inhalation, ingestion and, in a few cases, through theskin.

Mercury: Mercury is a volatile liquid metal. Exposure occurs in chemical laboratories, the manufacture of pesticides.

***Inorganic mercury compounds*:** cause stomatitis, a brown line on the gums, loose teeth, metallic taste, tremors and personality changes. There is kidney affection and gastrointestinal disturbances.

Organic mercury (pesticides): exert their effect on the central nervous system. Mercury fulminate (an explosive) causes skin ulcers and perforation of the nasal septum.

Arsenic: Exposure occurs in mining and extraction. Arsenic compounds are used in pesticides, wood preservatives and the chemical industry. Acute exposure causes severe gastroenteritis, shock and even death. Chronic exposure to arsenic causes affection of the peripheral nerves, skin lesions, skin cancer, anaemia, perforation of the nasal septum and lung cancer.

Pulmonary dust diseases: If the work atmosphere is dusty, dust will inevitably be inhaled.Dustparticles below five microns in diameter are called respirable since they have the chance to penetrate to the alveoli. The respiratory tract has certain defence mechanisms against dust but

when the environment is very dusty a significant amount of dust can be retained in thelungs.

Different kinds of dust have different effects:

Soluble particles of toxic compounds reach the blood and cause poisoning, e.g. lead.

Irritant dusts cause irritation of the upper respiratory tract and the lungs and certain metal fumes cause chemical pneumonia, e.g. cadmium, beryllium andmanganese.

Some others cause sensitization resulting in asthma or extrinsic allergic alveoli is, e.g. some organic dusts.

2.8 Farm animals and organisms and associated Biologicalhazards

Workers may be exposed to infections and parasitic agents at the workplace. Persons working with animal products and agricultural workers are likely to be exposed to biological hazards.

Human diseases caused by work-associated exposure to microbial agents, e.g. bacteria, viruses, rickettsia, fungi and parasites (helminths, protozoa), are called occupational infections. An infection is described as occupational when some aspect of the work involves contact with a biologically active organism.

Exposure occurs among health care workers in fever hospitals, laboratories and general hospitals; among veterinarians and agricultural workers in animal husbandry and dairy farms and pet shops

- **(Occupational) pulmonary tuberculosis**

Health care workers in tuberculosis treatment centers, in laboratories and in veterinary clinics are particularly affected. The disease is caused by Mycobacterium tuberculosis (Koch‘s bacillus) and is transmitted occupationally by droplet infection, contact with infected material from humans (sputum) or animals. The organism can survive in dust and away from direct sunlight for many days and enters the body through the respiratory tract or abraded skin where it causes a skin ulcer.The disease usually affects the lungs but can also affect the gastrointestinal tract,

bones, kidneys, meninges, pleura and peritoneum. Pulmonary tuberculosis is manifested by coughing, expectoration, haemoptysis, loss of weight, loss of appetite, night sweats and night fever. It can be diagnosed by chest X-ray and bacteriologicalexamination of thesputum.

Workers should undergo a pre-placement examination and be tested with tuberculin and vaccinated with BCG if the tuberculin test is negative. Pre-placement and periodic X-rays should be taken. Health education is important and proper disposal of infected material should be observed.

- **Brucellosis**

Brucellosis is caused by an organism which can infect cattle, sheep and pigs. The disease causes recurrent abortion in animals and is present in the placenta, in animal secretions, in milk and in urine. Exposed workers are veterinarians, workers in agriculture and animal husbandry, shepherds and laboratory and slaughterhouse workers. Most occupational cases occur through contact with infected animals or their secretions and products. The incubation period is 2–4 weeks.

The acute stage (undulant fever) extends for 2–4 weeks with fever, enlarged spleen and lymph nodes. In the sub-acute phase the organism localizes in joints, intestines, reproductive organs, pleura or meninges. In the chronic phase the localized disease continues with occasional fever or the only symptom may be general weakness. During this stage the disease is difficult to diagnose. Therefore, periodic medical examination of all exposed workers should be carried out using serologicaltests.

Control of the disease in humans depends on control in animals. Workers should wear protective clothing and observe proper cooking of animal products and boiling of milk since the disease can also be transmitted through food.

- **Anthrax**

Anthrax is essentially an animal disease. Exposed workers are those in agriculture and animal husbandry, slaughter houses, tanneries and those working in the manufacture of goods from wool, hair, bones and leather. The disease affects cattle, sheep, horses and pigs and when the animal dies

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the anthrax bacillus forms spores which are extremely resistant and can survive for years.

Infection can occur through the skin, the lungs or the intestine. Infection through the skin causes a–malignant pustule .It starts with erythema 1–8 daysafter infection which leadsto a papule then pustule with surrounding swelling and local lymph nodeenlargement.

2.9 Mechanical hazards associated with thefarmers

There are numerous types of work-related musculoskeletal disorders that are reported in agriculture. Farmers on an average have a smaller stature and have less physical strength; their vital capacity is 11% less; their hemoglobin is app. 20% less; their skin area is larger as compared to circulating volume; They have lower heat tolerance and greater cold tolerance. So they are more prone to mechanical hazards. These include disorders of the back pain, neck pain, tendon, shoulder disorders, cumulative trauma disorder, repetitive motion disorder, carpel tunnel syndrome. Mechanical hazards, unshielded machinery, unsafe structures in the workplace and dangerous tools are some of the most prevalent workplace hazards in developed and developing countries. Approximately 30% of the workforce in developed countries and between 50%-70% in developing countries may be exposed to a heavy physical workload or ergonomically poor working condition, involving much lifting and moving of heavy items, or repetitive manual tasks. These can lead to injuries and musculoskeletal disorders. Such disorders are the main cause of both short-term and permanent work disability and lead toeconomiclosses.The mechanical hazards in

Industrycentre round machinery, protruding and moving parts and the like. About 10% of industrial accidents are due to mechanical causes.

2.10 Psycho-social hazards

Occupational stress is one of the major problems from a gender perspective. Stress caused by time and work pressures has become more prevalent during the past decade. Monotonous work, work that requires constant concentration, irregular working hours, shift work, and seasonal-work can also have adverse psychological effects. Psychological stress and

overload have been associated with sleep disturbances, burn-out syndromes, depression and hypertension. Social conditions of work such as gender distribution, segregation of job and equality in the workplace raise concerns about stress in the workplace. Besides farm activities farmwomen involve in domesticactivities.

These arise from the worker‘s failure to adapt to an alien psychosocial environment. Frustration, lack of job satisfaction, insecurity, poor human relationships and emotional tension are some of the psychosocial factors that may undermine both the physical and mental health ofworkers.

2.11 Ergonomically hazards

Ergonomics involve the environment, the tool, the workstation, the task, the organization. It goal to reduce work-related musculoskeletal disorders (MSDs) developed by workers (Nag PK, Pradhan CK;1992). MSDs are injuries and illness that affect muscles, nerves, tendons, ligaments, joints or spinaldisks.

Common symptoms of MSDs are painful joints, numbness in hands, waists, forearms, shoulders, knees and feet, back or neck pain. Swelling or inflammations are common. Risk factors are static posture, forceful exertion, repetitive movement, extreme range of motion, awkwardposture

2.12 Stress

It can be defined as a reaction to a short-lived situation, such as working in un-ventilated kitchen under smoky, hot environment and less illumination. Or it can last a long time if respondents/workers are dealing with dangerous machine, a spouse‘s death or other serious situations. Stress becomes dangerous when it interferes with respondent‘s/ worker‘s ability to live a normal life over an extended period. Respondents/workers may feel tired, unable to concentrate or irritable. Stress can also damage respondent‘s physical health. Therefore it is very necessary to find out the health hazards associated with the farm women at their work places (household, farm and animal rearing). The household activities such as collection of fuel & fodder, fetching of water, cooking, feeding & caring of domestic animals, milking, cleaning of shed and disposal of animal wastes

are the tedious tasks perform by the women without any help of familymembers.

2.13 Physical hazards

Physical factors in the work place such as noise, vibration, poor illumination, ionizing and non- ionizing radiation and microclimatic conditions can all affect health adversely. Noise-induced hearing loss is one of the most prevalent occupational health effects in both developing and developed countries. Contact with wild and poisonous animals: insects, spiders, scorpions, snakes, certain wild mammals can affectheath.

2.13.1 Thermal stress : Thermal environment

The temperature of the human body when healthy is at a constant of around 37 °C through a dynamic balance between heat production and heat loss. The heat regulating centre in the hypothalamus controls this balance.

Heat is produced by the metabolic processes, by muscular activity and by food consumption. Heat is exchanged with the surrounding environment by conduction, convection, radiation and evaporation of sweat. Heat exchange is influenced by air temperature, air velocity, relative humidity and radiation. Various combinations of these factors can cause different degrees of comfort and discomfort and several indices have been described to express the degree of thermal stress resulting from combinations of these factors, e.g. the effective temperature, the corrected effective temperature and wet-bulb-globe temperature indices.

>Types of thermal stress

2.13.2 Cold stress: This exists when the surrounding temperature falls, as occurs when entering cold storage rooms. A human tries to reduce the exposed skin surface (by bending the joints if possible or by wearing thick woolen clothes). Peripheral vasoconstriction of skin vessels occurs resulting in vascular injury, chilblains, frost bite (dry gangrene) or trench foot (wet gangrene). Heat production increases through increased muscle tone and shivering. Extreme cases result in hypothermia, lowering of the temperature of core organs anddeath.

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2.13 3 Heat stress: thestages

Vasomotor control: As the heat stress increases, more blood is pumped to the skin and less to the visceral organs and brain. There is cardiovascular stress and tachycardia. Muscular work is reduced since it produces more heat. Heat exhaustion is manifested by headaches, dizziness, sleepiness, lack of concentration and anorexia.

Evaporative cooling: The body starts to sweat with the amount related to the degree of stress and acclimatization. Loss of sodium chloride through sweating causes heat cramps (painful cramps starting in the working muscles and spreading to other muscles) and dehydration which aggravates cardiovascular problems. The volume of urine is reduced. High air velocity and low relative humidity help cooling through the evaporation of sweat. Dry heat exposure is encountered in foundries, steelmills and in the glass industry and moist heat exposure in textile mills, mines, the food canning industry and laundries.

Heat stroke: If sweating is not sufficient to keep the body temperature within the physiological range, the heat regulating centre fails, sweating stops, the skin is flushed and the patient is said to suffer from heat stroke. Unconsciousness and death may follow. Heat stroke occurs in workers in hot humid environments especially when exposed to direct sunlight. It is an emergency situation where rapid cooling, rehydration and replacement of electrolytes are indicated.

2.14 Occupational cancer: A threat to theworkers

The cause of cancer is still not completely understood. It has been observed however, through epidemiological studies and statistical data that cancer of certain organs has been associated with certain exposures.

Occupational cancer is no different from ordinary cancer as far as signs and symptoms or histopathology is concerned. A positive history of exposure to a carcinogenic agent can be obtained in occupational cancer. Examples of some carcinogenic agents and the organs affected are given below.

Carcinogenic agent	Organs affected
Arsenic	Skin abnormalities
Chromium compounds, hexavalent	Lung
Polycyclic aromatic hydrocarbons	Skin
Ionizing radiation	Skin, bone, lung, blood(leukaemia)

Reproductive effects

Occupational exposure to certain chemicals or physical factors (like ionizing radiation) has been found to have certain effects on reproductive functions:

- Dysfunction in males (sterility or defective spermatozoa) and females (an-ovulation, implantation defects in theuterus)
- Increased incidence of miscarriage, stillbirth and neo-nataldeath
- Induction of structural and functional defects in newbornbabies
- Induction of defects during the early postnatal development stage. Exposure of either parent may lead to reproductivedefects.

Chemicals which have been suspected of reproductive effects include:

1. Alcohols
2. anaesthetic gases
3. cadmium
4. carbondisulphide
5. lead
6. Manganese polyvinylchloride.

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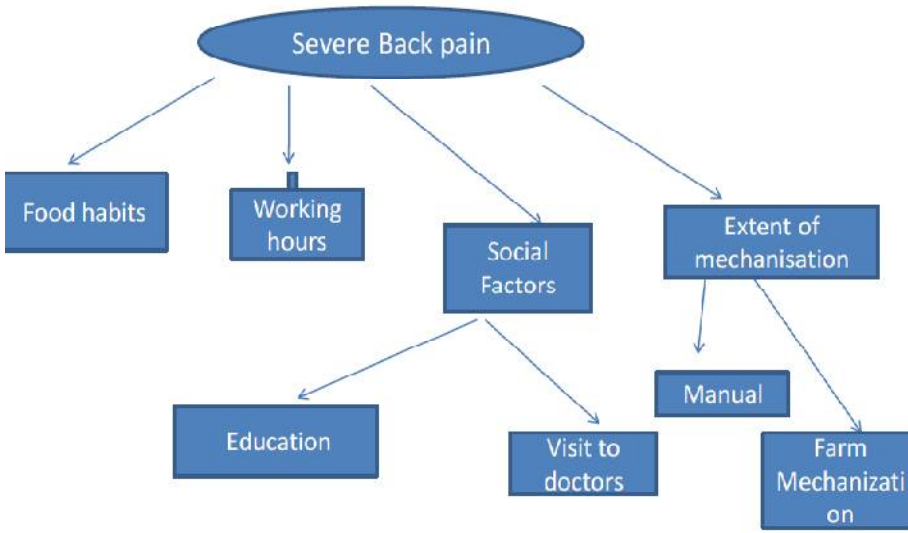
2.15 Some mostly prevalent health hazards among the farm women and their probablecauses:



2.15.1.Severe-Back-pain

- Probable causes and revelation –
- In case of working hour, it is seen that little or almost no resting period is offered in 6-7 hours workinghour.
- In case of food habit, composition of vitamins, minerals, proteins, fat and carbohydrate are not at par standard rate. time of taking food is also not always properly maintained.
- In case of extent of mechanization, farm women are always engaged in manual works. Men always enjoy most of themechanizations.
- Some studies these have also revealed that,

Farm women are mainly engaged in arduous field operations like sowing, transplanting, inter-culture operations, harvesting and threshing and when they are performing these tasks, they have to adopt some postures like squatting, stooping, standing or bending and so one. Many of this farming activities call for mobility in squatting and being very stressful

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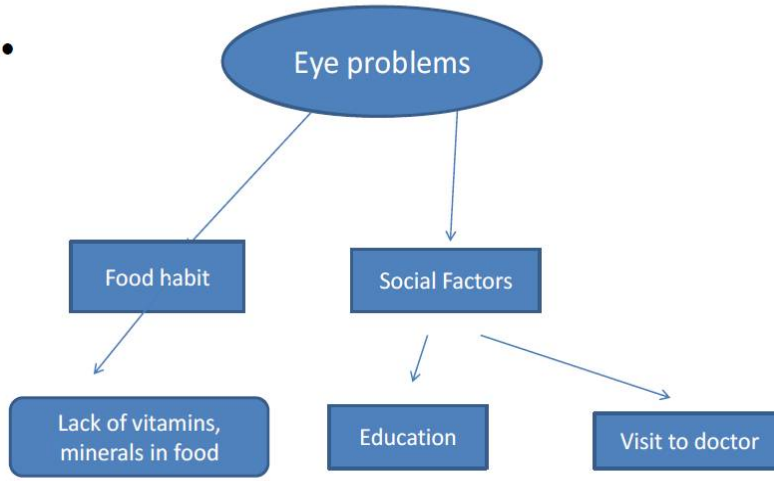
cause fatigue of the back muscles, if it is continued, it causes stress to the ligaments and the bone structure. In turn, Musculoskeletal disorders (MSDs) appear.

Besides, hindrance of the blood vessels may result in fatigue and degeneration of muscle fibres.

So,there is no doubt that the tasks being performed by the farm women are somewhat responsible to the impairment of their health and develops severe back-pain.(IJHS;2016)

2.15.2 Eyeproblems



Probable causes and revelation-

- Majorityoftherespondentsaresufferingfromdifferenttypesofeyeproblems,includingeyesight,conjunctivitis, migraine etc.
- The problem-cause diagram depicts that, less consumption of vegetables and poor consumption of food, lack of education and a defying attitude to visit doctors may be responsible for the farm women to comply with the eye problem.
- In rural farm families, the vitamins enriched food, adequate and scientific rationing, hygienic practices to support nutritional level and

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proper health dynamics. A kind of awareness program is also necessary. Since, most of them are away from pedagogical exercises and mostly engaged in household activities, household chores and farm activity,the importance of eye health is not properly perceived or taken care of either.

- **Specific fungicides that appeared to drive this eye associated problems were maneb or mancozeb and ziram. No associations between pesticide use and other eye disorders werefound.**

Although these findings for retinal degeneration are based solely on self-reported disease, they are consistent with those reported in case of farmer -pesticide applicators. These findings suggest that exposure to some fungicides and other pesticides may increase the risk of retinal degeneration and alertfor further investigation.

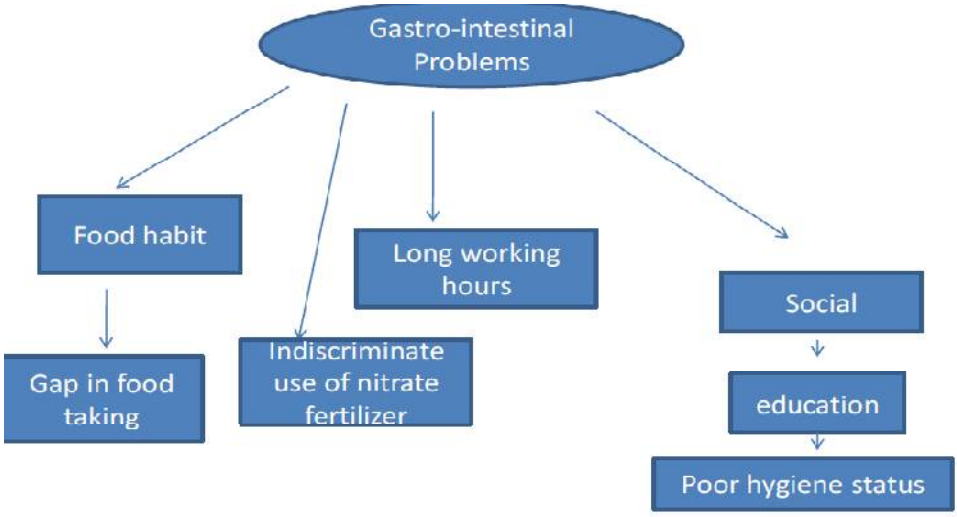
The most common form of retinal degeneration, macular degeneration, is the leading cause of decreased visual acuity and loss of central vision among older adults in industrialized countries (American journal of epidemiology and Pauleikhoff D). Some of the known risk factors are age and family history,but smoking, hypertension, cardiovascular diseases related to atherosclerosis, cataract surgery, alcohol consumption, obesity, light exposure, and eye color are considered as possible risk factors. (Klein R et al.) Exposure to pesticides may increase the risk of retinal degeneration. Studies in Japan havelinked organophosphate exposure to _Saku' disease, which involves retinal degeneration and other adverse ocular effects (DementiB,Zhassi). In a study from India, the prevalence of macular degeneration was higher among pesticide workers exposed to the organophosphate Fenthion than among unexposed ones (MisraUK et al.). A link between organophosphates and retinal degeneration is supported by animal data also (DementiB.,Boyes WK et al). Case reports have implicated organochlorines and carbamates in ocular toxicity (Morse DL et al and Taylor JR et al.), and animal studies have implicated two fungicides, thiramandbenomyl, in retinal degeneration (Maita K et al. and Hellman B et al.).

Personal and lifestyle characteristics included age, state of residence, race, education, obesity, eye colour, fruit and vegetable consumption,

tendency to sunburn, employment off the farm, exercise, smoking, and alcohol consumption. Cases of other eye disorders and medical conditions which are potentially associated with retinal degeneration were ascertained similarly. These other eye disorders and medical conditions were retinal detachment, glaucoma, cataract, diabetes, head injury, lead poisoning, solvent poisoning, pesticide poisoning, angina, arrhythmia, hypertension, myocardial infarction, and stroke.

Two separate models defining pesticide use by function (four classes) and chemical structure (three classes) were specified. Each model included covariates and all of the classes. In secondary analyses, we explored the associations of pesticide groupings with detached retina, cataract, and glaucoma.

2.15.3. Gastro-intestinal problems



Probable causes and revelation –

- When the Nitrogen fertilizers applied in the crop field, a good amount of N2 is leached and mixed with the ground water being a highly soluble element. As we know, nitrogen fertilizers have near about 30 % use efficiency. And these contaminated water is taken by the farm workers It may cause physiological hazards.

- Besides, there is the fluctuation of water table. In the summer day there deficit of water are occurred and in the rainy days, water level becomes high and wastes, feces are mixed with the water are chances of diarrhea occurred.
- The farm workers mainly the farm women, take lots of oily, soiled food, which later forms gas and acids and affect stomach and liverbadly?
- The farm families also have poor hygienic knowledge and awareness, which, in turn, damages their health, causes gastro-intestinalproblems.

Socio-demographic factors such as gender, age, and education, among others, combine individual profiles and some environmental factors,

Such as food culture (including food preparation and consumption habits), working conditions (physical and mental demands and time spent performing work), workload and frustration level at work, and use of pesticides in cultivation. These all factors may exacerbate morbidities, which appear as symptoms, and their origins can be confirmed by clinical diagnosis. In addition to the factors associated with individuals, environment, and labour, use of pesticides can cause clinical complications, including inflammation, gastritis, esophagitis, and stomach cancer.

Evidences of the associations between gastric disorders and pesticide application by rural workers have been reported in some literatures. (KhuranaP, Bansod YV, Wani M, de Castro AB, Neitzel RL et al.) A study involving individuals who applied pesticides reported gastro-intestinal symptoms, including nausea, vomiting, severe abdominal pain or discomfort. These symptoms were attributed to gastrointestinal irritation produced by the release of phosphine into the stomach.(Khurana P et al.) Gastric disorders have also been reported in cases of mild intoxication due to the pesticide Abamectin.(Bansod YV et al.) This complication was more prevalent in women than in men which is of serious concern. In addition most of the cases of gastric disorders are more prone to women, which has revealed in other studies.(Ahmed S et al.). The type ofwork they perform, which is tiring, exhausting, heavy, without a fixed schedule, and its success is dependent not only on workers but also on the weather and these all may bersponsible.(Neitzel RL et al.)

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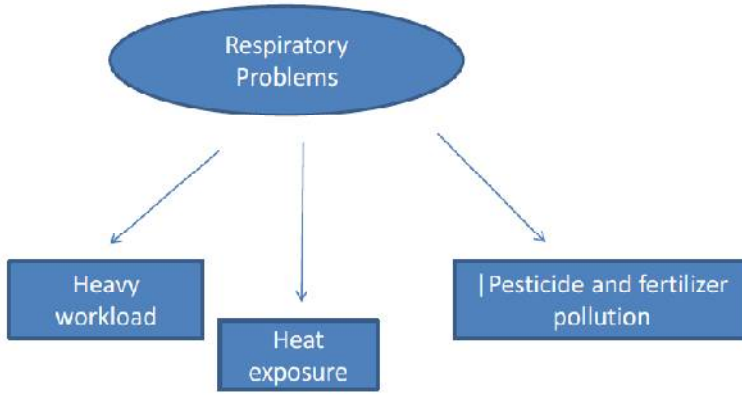
A previous study involving men and women and investigating on the use of their time to reconcile work and family life indicated that women were tied to domestic responsibilities and that this might contribute to increased stress. (Rafnsdottir GL et al.) A study on the inequality of domestic work in British couples showed that the women felt burdened not only by the domestic work but also other activities and by not sharing household chores with their companions.(Schober PS)

One study has reported the experience of patients with gastroparesis indicated that the main symptoms of the disease were nausea, vomiting, and depression and that the behaviours of patients with this diagnosis were associated with feelings of loss, isolation, and rejection. (Bennell J et al.)

Domestic work, in most of the cases combined with other activities, has been reported in the literature as a stress factor (Rafnsdottir GL, Schober PS et al.)) However, in some study, it was identified as a protective factor for gastric disorders. This finding underscores the effort to correlate food culture with its behavioural effects. Moreover, the findings indicate that time spent in rural activities increases both the prevalence of gastric disorders and the level of frustration in relation to these activities by5%.

The length of daily work and frustration at work contribute to the development of health problems, including gastric disorders characterized by gastric pain, nausea, and vomiting(Ahmed S et al).

2.15.4.Respiratory problems



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Probable causes and revelation –

- A good number of farm women are suffering respiratory problems. There may be several causes:
- The nitrogen fertilizers which are applied, later nitrous gas and if sulfur fertilizers, SO2 is emitted.It mainly occurs in Boro field. All the gaseous compounds say chlorides,add their offing during summer rice and vegetable cultivation. And when, during working the farm women inhale this toxic compounds, there respiratory health is severely impaired.
- Besides, the working hour of the farm women is quite long i.e. 6 to 7 hour. They have to work under scorching of sun and they inhale the deleterious gases for longer period of time. So the duration of exposure to this harmful environment is responsible for their poor health.
- There is also a problem, we may call it _pseudo-farming'. In the farm-household, from the gathered raw straw, ammonia gas is emitted and when parboiling of rice is done, inhalation of some toxic gases like carbon mono-oxide, methane occurs. These, all causes severe respiratory problem s.

Some of the commodities result in varying exposures to the respiratory tract and include organic dusts, gases, microorganisms, infectious disease, and agricultural chemicals, including pesticides. Farm sitesandworkpracticesthatareassociatedwithrespiratorytoxinsincludebarns,chicken coops,silos,

grain bins, applying pesticides to crops and vegetables, and manure storage pits.(Steven R) Organic dust is a complex mixture of vegetable matter, pollens, animal waste, insect, rodent and bird faces, feathers, microorganisms, bacterial and fungal cell wall toxins, pesticides, and antibiotics and can be thought of as a chemical soup. These components lead to an inflammatory response in the mucous membranes and respiratory tract of the farm workers. The components can lead to simple inflammation or an IgE-mediated immune response to allergens contained in the dust.There are many **allergens** viz. animal products, antibiotics and

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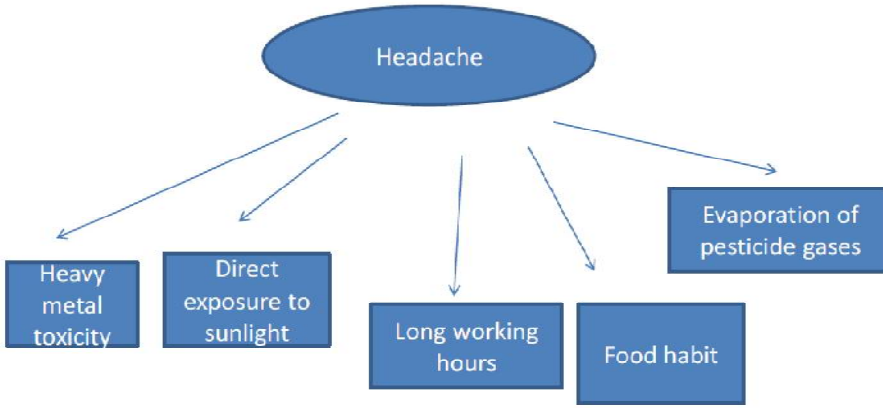
animal feed additives, pollens, storage mites, fungal and bacterial molds, and protein components of grain dusts etc. **Bacterial sources** include particularly thermophillic**actinomycetes**such as *Saccharaopolysporarectivirgula*, and **fungal molds**, particularly members of *Aspergillus*genus, are associated with sensitization leading to hypersensitivity pneumonitis. Allergic conditions can include upper airway allergic symptoms such as rhinitis, as well as asthma. The levels of molds and bacteria are can be extremely high, particularly in moldy bedding, feed, and silage. High levels of dusts and molds are associated with particular activities such as unloading grain bins, and silo unloading and uncapping in the fall.

Aerosols that are inhaled while working in these areas contain in the range of 104 to 107 bacterial colony forming units/ cubic meter (cfu/m3) and 103 to 106 fungal cfu/m3. The size of these particles is also important and range from less than 0.1 microns to 100 microns. **Respirable dust particles** or those particles that are 5.0 microns (*u*) in diameter or smaller, make up 40% of the organic dust and penetrate deeply into the air exchange unit consisting of the terminal bronchioles and alveoli. Respirable particles primarily damage the lower airways and terminal alveolar unit while the larger particles that settle out in the upper airways and are associated with upper airway irritation. A significant component of grain dust associated with inflammation is bacterial **endotoxin**. This consists of a heat-stable lipopolysaccharide (LPS) found in bacterial cell walls, primarily from gram-negative bacteria, and released with bacterial death and cell wall lysis. LPS contains the biologically active lipid A that is considered to be responsible for the inflammatory effects including animal confinement **operations, livestock farming, grain elevators, and potato processing.** Grain handling, manual harvesting of tree fruit and grapes, Christmas tree farms, potato harvesting, and small vegetable harvesting by hand can also cause an exposure to inorganic dust.

Besides, burning stubbles, particularly rice stubble, can also expose workers to aerosolized inorganic dust (McCurdy et al, 1996). Inorganic dust is not as significant as organic dust or as toxic as industrialsources of quartz dust. Those individuals with underlying chronic obstructive pulmonary

disease, including asthma and chronic bronchitis, can experience aggravation of the underlying disease.

2.15.5. Headache



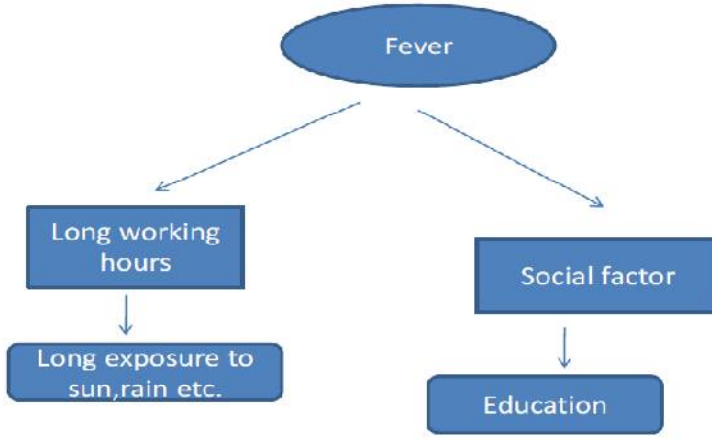
Probable causes and revelation –

- The farm women are always under stressful ambience. Due to the long working duration and almost no resting period, Oxygen deficit occurs in their blood. And it may lead toheadache.
- In case of long exposure to sunlight, it is evident that farm women do not wear any caps while they work in the field. So, continuous heating problem may cause headache. But, farmers always wear a cap or hat or some indigenous head covers for protection fromsunlight.
- Almost all the farm women take lunch in delayed time with an unscientific rationing, leading to hyper acidic condition in stomach. Because of this, headache happens.
- Heavy metals accumulate in the food chain through the food taken. And the enter into the human body and causeharm.
- Various forms of headache (e.g., chronic daily headache, tension-type headache, migraine headache) are disabling conditions (Stewart WF, Scher AI, Lipton RB et al.) that, compared to other common pain conditions, produce the greatest loss of productive time in the US workforce (Scher AI et al.). Because the prevalence of the different

forms of headache varies widely in published studies (e.g., 1.3–86% for tension-type headache (Stewart WF et al.) it is difficult both to derive a definitive estimate and to assess whether the headache prevalence has changed over time (Rasmussen BK et al). Headachehas been shown to be associated with breathing disorders, caffeine consumption, alcohol consumption, hypertension, anxiety, and depressive disorders (Peres MFP et al.). Emerging evidence from case–control (Bigal ME et al.) and observational studies (Brown WJ et al) suggests that increased BMI (kg/m2) might be a risk -factor forheadache.

It has been established that headache prevalence is much higher among women (Lipton RB et al.). And increased BMI may be associated with decreased risk of headache among the category of women.

2.15.6. Fever



Probable causes and revelation –

- The farm women work under open sky, under the scorching ray of sun and under the rain throughout the year. And these causes the health problem like fever.
- Most of the farm women do not cover their head or wear any cap when work in the field.

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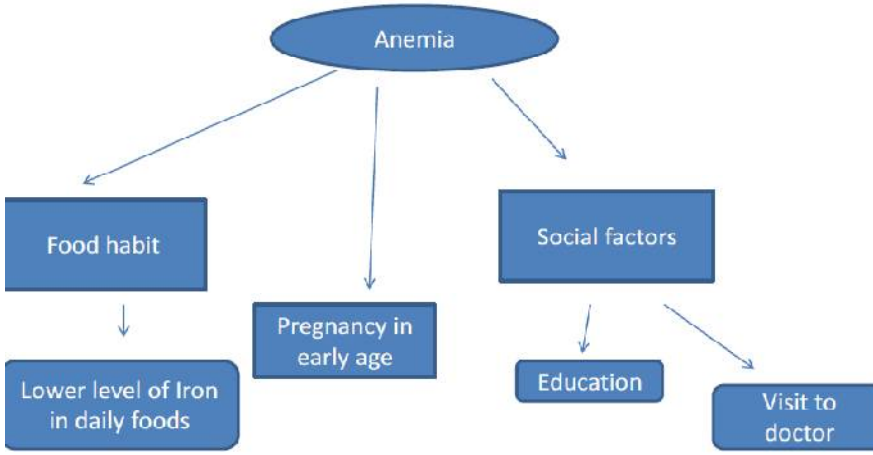
2.15.7. Anaemia



Probable causes and revelation –

- Basically, the food habit is one of main reason behind anaemia. They mainly takes iron poor food and the duration of eating is irregular and has a hugegap.
- During pregnancy normal weight gain is 10-12 kg but loss of weight gain occurs in case of farm women. Due to hard working and lack of rest or conceive at an early age. It results in pre-term delivery or miscarriage. And in turn, it causesanaemia.
- As they have a low level of literacy, they ignore the problem at early stage and do not make visit to doctor to analyse theproblem.
- Nutritional anaemia is one of India‘s major public health problems. The prevalence of anaemia ranges from 33% to 89% among pregnant women and is more than 60% among adolescent girls. Under the anemia prevention and control program of the Government of India, iron and folic acid tablets are distributed to pregnant women..Anaemia in women and adolescent girls has serious health implications. Severe anaemia during pregnancy significantly contributes to maternal mortality and.. There is evidence that severe anaemia also increases prenatal morbidity and mortality. Anaemia in women affects their

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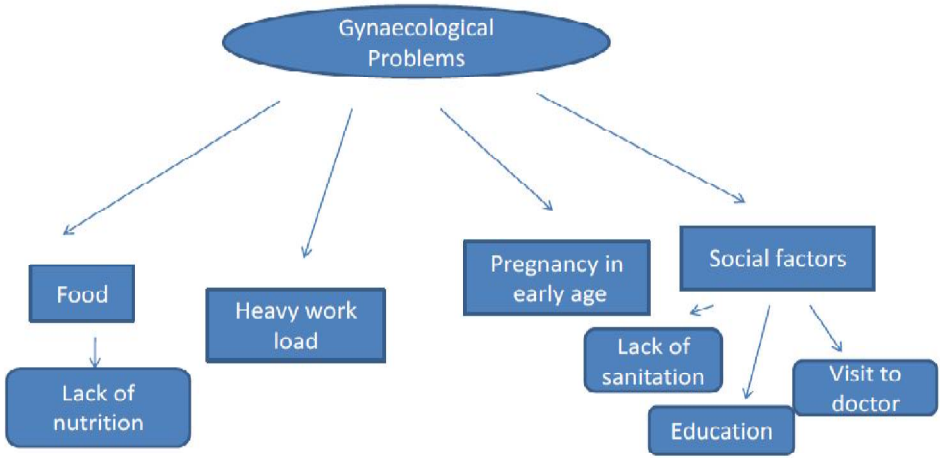
physical work capacity and reproductive physiology. According to a World Health Organization (WHO) report (1992), the global prevalence of anaemia among pregnant women is 55.9%. In India, the prevalence of anaemia in pregnant women has been reported to be in the range of 33% to 89%. Anaemia results from nutrition-related causes and from inflammatory or infectious diseases, as well as from blood loss. Iron-deficiency anaemia resulting from inadequate intake and low absorption of dietary iron is the most common form of anaemia inIndia.

The main caused behind the malnutrition especially in rural areas are inadequate health education of mothers, inadequate nutrition, poor environment, hygiene, large family size etc. Human behaviour is subjected to change with environmental and motivational factors. It explores and adopts new ideas that suit to its need. This is the basis for providing nutrition education to the masses. Ignorance is one of the root causes of disease, which calls for nutrition education of people. Nutrition and health education have been an effective educational measure for including desirable behavioural changes for the ultimate improvement in the nutritional and health status of individuals. It moves the individual from lack of interest and ignorance to increasing appreciation, knowledge and finally leads to action.

Nutrition education can be an effective way of combating anaemia and it can help farm women in proper selection of iron rich foods for their children. Anaemia is probably the most extensive nutrition deficiency disorder in India affecting 77 per cent of farm women. (Study of iron deficiency anaemia in farm women of Lucknow district in UttarPradesh,India)

2.15.8. Gynecological problems



Probable causes and revelation –

- Because, the farm women do not follow proper rationing of food. It lacks many minerals, vitamins etc which affects their health.
- Due to lack of sanitation, continuous exposure to unhygienic ambiences their gynaecological health is severelyimpaired.
- Problem of menstruation for heavy load lifting during work like lifting of bags full of grains in case of adolescence and menstruatingfemale.
- Pregnancy at early age is one of the main causes. Besides, due to lack of proper nutrition during pregnancy, pre-term delivery or miscarriage happen. And sometimes, the pregnant farm women have to bent during work, it affects theirhealth.

According to some studies, though direct exposure to pesticides is higher among men but women also get exposed because of re-entry into the field for weeding, thinning or some other intercultural operations. As we know that, assessment of fertility in women is more difficult to the men. And ovarian disorders may be caused due to a lot of factors from high levels of physical activity, age, stress, caffeine intake to exposure to chemicals such as benzene and poly-chlorinated biphenyls (PCBs) which can affect menstrual cycle. But exposure to particular pesticides may induce ovarian dysfunction.

A recent study have assessed the association between pesticide exposure and menstrual cycle. They observed that, women who worked with pesticides suspected of being hormonally active had a 60-100 %increment in odds of experiencing long menstruation cycles, missing of periods in due time and inter- menstrual bleeding compared to women who had never worked with pesticides. Besides, an increased risk of infertility was observed among women exposed to pesticides or working in the agricultural field.

Some pesticides may interfere with the female hormonal function and thereby cause negativeeffects on the reproductive system. Most previous studies focused on interference with the oestrogen and/or androgen receptor, but the hormonal function can be disrupted in many more ways through pesticide exposure.

Some problem also occurs in the female body, which may lead to sub-fertility, i.e. Inability to conceive. The problems will be discussed below -

1. Ovulationdisturbances

Problems with ovulation account for sub-fertility in another 20 – 25% of couples and are thereby a frequent cause of sub-fertility in women. Ovulation problems present themselves as irregular or absent menstrual periods and can be substantiated through measurement of reproductive hormones.

2. Unexplained sub-fertility

Despite advances in the diagnosis of causes of sub-fertility, inability to conceive remains unexplained in 2530% of fully investigated couples.

An important factor in female sub-fertility is age. The risk of sub-fertility increases from 10% to 30% when women are over 35 years of age. Hormonal balance is another important factor in female fertility, in particular regarding the ovarian cycle. Lifestyle factors, including stress, extreme body weight (too low or too high), coffee consumption,diet, and excessive exercise can affect a woman's hormonal balance and subsequent adulatory pattern. Hormonal imbalance and adulatory problems are much less often caused by hormonal diseases, such as pituitary gland tumours.

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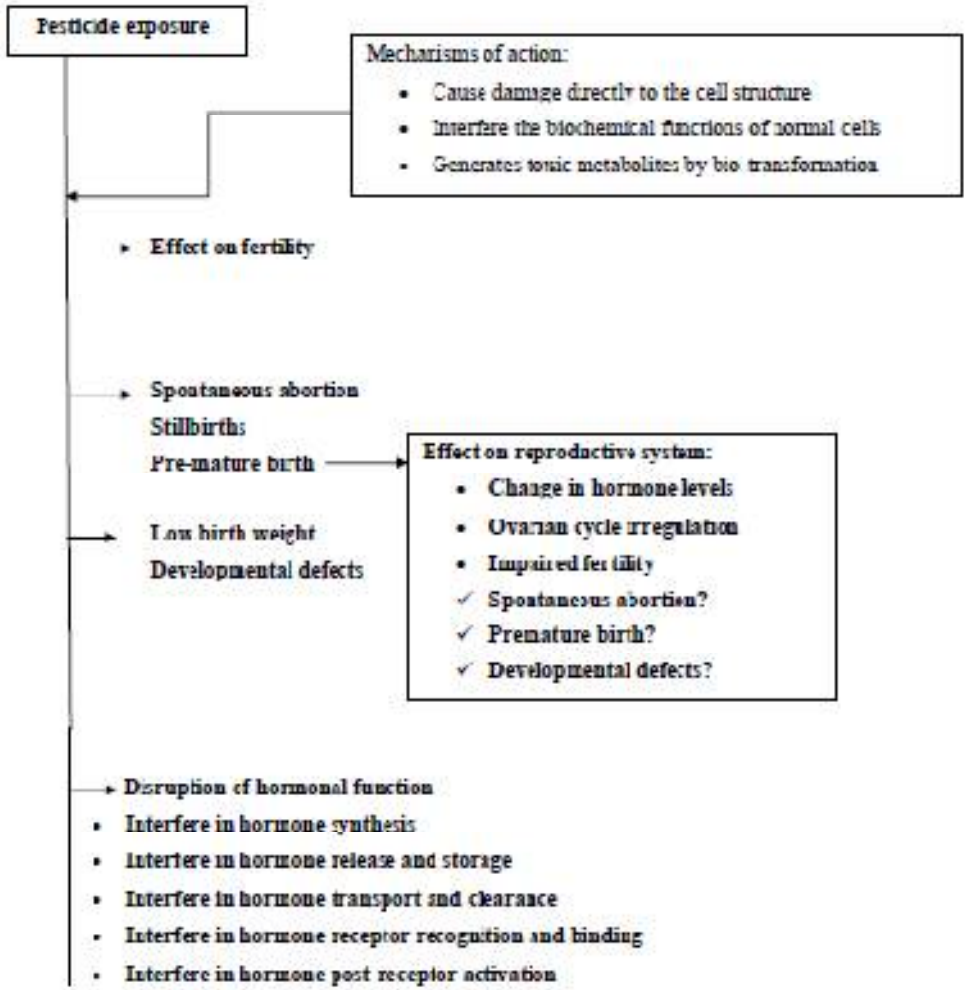
But there are indications that endocrine disrupting chemicals, such as PCBs and certain pesticides, can influence the hormonal balance and thus increase the riskofsub-fertility.

Fig. 2.15.7. Potential effects of pesticide on female reproduction



with pesticide exposure in women are decreased fertility, spontaneous abortions, stillbirth, premature birth, low birth weight, developmental abnormalities, ovarian disorders, and disruption of the hormonal functionPesticides that may disrupt the hormonal function are often called

endocrine disrupting chemicals (EDCs), just like other agents with similar mechanisms of action. An ECD may be defined as an exogenous agent that interferes with the synthesis, secretion, transport, binding, action, or elimination of natural hormones inthebodythatareresponsibleforthemaintenanceofhomeostasis,reproducti on,developmentand/orbehaviour Endocrine disruptors are usually either natural products or synthetic chemicals that mimic, enhance (agonists), or inhibit (antagonists) the action of endogenous hormones. Body burden, dose, timing, and duration of exposure at critical periods in life are important considerations for assessing the risk of an adverse effect of endocrine disruptors. In the next paragraphs, we will review the ways in which pesticides may disrupt the female hormonal function of the reproductive system on the basis of experimental animal studies (*in vivo*) and cell culture studies (*in vitro*), which often provide the first indications of potential reproductive effects.. We only describe possible mechanisms of disruption mentioned in the literature to indicate hazards, without judgement about human risks based on dose-response relations.

- **Disruption of the female hormonal function**

1. Interference with hormone synthesis All hormones differ in their chemical structure and have a different route of synthesis with innumerable different steps. If one substance or link is disturbed in the chain of hormone synthesis, the hormone may not be produced or may get different properties. Some pesticides, such as fenarimol, prochloraz, and other imidazole fungicides possess the ability to inhibit estrogen biosynthesis through CYP19 aromatase inhibition *in vitro*, preventing the conversion of androgens to estrogens. Vinggaard*et al.* hypothesized that compounds which can inhibit aromatase acitivity*in vitro* may be able to cause local changes in estrogen and androgen concentrations*invivo.* Aromatase induction is a physiological mechanism to deactivate xenobiotics, which does not inevitably cause a toxic effect. The pesticides atrazine, simazine, and propazine (2-chloro-triazine herbicides) induce aromatase activity *in vitro.* For p,p-DDE, the induction of aromatase has been demonstrated *in vitro* and *in vivo.* In addition, the pesticides methomyl, pirimicarb, propamocarb, and iprodion can weakly stimulate

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aromatase activity, whereas heptachlor may act as an inducer of testosterone 16-alpha and 16-beta hydroxylases.

Thiram, Sodium N-methyldithiocarbamate (SMD), and other dithiocarbamates are known to suppress the dopamine-beta-hydroxylase activity leading to reduced conversion of dopamine to norepinephrine. This may lead to changes in hypothalamic catecholamine activity involved in generating the proestrus surge in LH, which stimulates the final stages of ovulation. Goldman *et al.* concluded that SMD is able to block the LH surge and ovulation in rats. Ketaconazole inhibits various enzymes which belong to the CYP450-dependent monooxygenases and also inhibits progesterone synthesis.

2. Interference with hormone storage andrelease

Interference with hormone storage and/or release is also mentioned in the definition of EDCs as a mechanism of action. Catecholamine hormones (e.g. norepinephrine) are stored in granular vesicles of chromomaffin cells within the adrenal medulla and within presynaptic terminals in the central nervous system. Therefore, they can be released quickly on demand. In contrast, steroid hormones are not stored intra-cellularly within secretory granules, but are readily synthesized after gonadotropin stimulation of the gonads. The formamidine pesticides chlordimeform and amitraz have been reported to blocknorepinephrine binding to the alpha 2-andrenoreceptors. Norepinephrine is critical for the preovulatory increase in the pulsatile release of GnRH and the subsequent ovulatory surge ofLH. Thiram suppresses the proestrus surge of LH and delays ovulation in the female rat [39]. Disruption in the timing of the LH surge could alter the viability and the quality of the oocyte and a potential conceptus by pre-ovulatory over-ripeness ovopathy (PrOO). Inhibition of progesterone secretion and poor conception occurred after malathion exposure at the onset of estruscattle.

3. Interference with hormone transport andclearance

For the most part, steroid hormones in the bloodstream do not float around freely, but are bound to carrier proteins, such as SHBG and albumin. Because only free hormones can be biologically active, increases or decreases in the concentration of SHBG will have a major impact on the

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available and active steroid hormone concentrations in blood. Estrogens are known to increase the synthesis of SHBG in the liver and thus increase the SHBG concentration in plasma, whereas androgens decrease these concentrations. Substances that mimic these natural hormones may cause similar changes, but no specific papers dealing with effects of pesticides on SHBG levels have been found. In contrast, reports are known about the influence of pesticides on clearance of steroid hormones, mostly occurring in the liver. The clearance rate is different for each hormone and is influenced by compounds that alter liver enzyme activity involved in hormone clearance. Many pesticides induce the liver enzymes monooxygenase and UDP- glucuronosyltransferase, resulting in increased clearance of the pesticide itself for detoxification purposes, but also of testosterone. For instance, DDT analogs are potent inducers of hepatic microsomal monooxygenase activity *in vivo,* which degrades endogenous androgens, resulting in suppressed androgen receptor mediated activity. These effects have also been suggested for endosulfan and mirex. Similarly, treatment with lindane has been reported to increase the clearance ofestrogens.

4. Interference with hormone receptor recognition andbinding

This mechanism of endocrine disruption is much discussed in the literature. Hormones travel from their point of release in the bloodstream to particular tissues where they convey their messages. For the message to be interpreted, hormones bind to receptors. Hormone and receptor have a precise fit, so that only a specific type of hormone can bind to a specific receptor. Member of environmental agents may alter this process by mimicking the natural hormone (agonists) orby inhibiting receptor binding (antagonists). The latter mechanism is based on complete or partial blocking of the specific receptor. Regarding the estrogen receptor, this mechanism only applies when the endocrine disruptor concentration is high, because the affinity of endocrine disruptors for the estrogen receptor is usually many times lower than that of 17-beta-estradiol. Three different mechanisms are elaborated below:

1. Binding and activating the estrogen receptor; 2. binding without activating the estrogen receptor; and 3. binding other receptors.

5.Interference with hormone post-receptor activation Ifan agonist binds to its receptor, a cascade of events is initiated for the appropriate cellular response necessary for signal transduction across the membrane or, in case of nuclear receptors, the initiation of or alteration in DNAtranscription and protein synthesis. Lindane has been demonstrated to decrease phosphatidylinositol turnover in the membrane and to reduce protein kinase-C activation. Steroid hormone receptor activation may also be modified by indirect mechanisms such as a downregulation, which is seen after TCDD exposure.

6. Interference with the thyroidfunction

Pesticides like chlorophenols, chlorophenoxy acids, organochlorines, and quinones have been shown to alter thyroid gland function and to reduce circulating thyroid hormone levels. Reduction in thyroid hormone levels can compromise the catalytic activity of hepatic cytochrome P450 monooxygenases, resulting in an altered hepatic androgen metabolism.

7. Interference with the central nervoussystem

The central nervous system (CNS) is very important in the integration of hormonal and behavioral activity. Disturbances in these finely tuned mechanisms can severely impair normal adaptive behavior and reproduction. Since many pesticides are known to be neurotoxic, it is conceivable that these chemicals can disrupt the coordinating activity of the CNS by disrupting brain cell functions.

Also, pesticides can alter the hypothalamic and pituitary function and thus secretion of GnRH, LH, and FSH in a more direct manner by modifying the feedback of endogenous hormones. For example, it has been demonstrated that low-dose exposure to o,p-DDT and methoxychlor can result in diminished hypothalamic and pituitary function in rodents. Finally, it is postulated that any environmental compound mimicking or antagonizing steroid hormone action could presumably alter the glycosylation of LH and FSH, thereby reducing their biologicalactivity.

- Potential effects of hormone disruption on the female reproductivesystem

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The function of the female reproductive system depends upon hormone concentrations and their balance. Endocrine disruption may result in disturbances in the reproductive system, such as modulation of hormone concentrations, ovarian cycle irregularities, and impaired fertility, which may be due to any of the mechanisms mentioned above. In many studies addressing these disturbances, however, the mechanisms are not specified. These studies, describing the effects of endocrine disrupting pesticides on the female reproductive system in more general terms, are summarized below. As the majority of these studies are experimental animal studies, one should keep in mind that the estrus cycleinanimals only partly corresponds with the ovarian cycle in humans, but that the phases (proestrus, estrus, metestrus, and diestrus) are different. Estrus is the period of greatest female sexual responsiveness usually coinciding with ovulation. Diestrus is the luteal phase of the estrus cycle when the female is not receptive to the male and the progesterone levels are high.

Female sexual responsiveness usually coinciding with ovulation.Diestrus is the luteal phase of the estrus cycle when the female is not receptive to the male and the progesterone levels are high.

Modulation of hormone concentrations

Hormonal balance, i.e. a proper level of sexual hormones, is important to preserve female reproduction and maintain fertility. This balance can be disturbed by changing levels of estrogen or progesterone. Estrogen levels may be decreased by several pesticides. Treatment of rats with the insecticide heptachlor suppressed estradiol concentrations in blood and reduced the production of estradiol by ovarian cells of treated rats. Lindane, atrazine, and simazine also cause a decrease in circulating estradiol levels in rats. In monkeys, ovulatory levels of estradiol were reduced after high doses of hexachlorobenzene, which also induced anovulatory cycles and suppression of circulating levels of estradiol, and a dose dependent suppression of serum progesterone concentrations during the luteal phase. Progesterone levels may be decreased by exposure to methoxychlor as well, especially during the estrus phase of the estrus cycle in rats. During early pregnancy, progesterone concentrations decreased after treatment with DDT in rabbits.

Ovarian cycle irregularities

The female ovarian cycle is the result of a balanced cooperation between several organs and is determined by a complex interaction of hormones. Ovarian cycle irregularities include disturbances in the ovarian cycle (e.g. longer cycle, persistent estrus) and ovulation problems (deferred ovulation oranovulation).

Disturbances in the ovarian cycle

Organochlorine compounds are known to interrupt the estrus cycle in rats. The number of estrus cycles and the duration of each phase of the estrus cycle were significantly affected after treatment of rats with methyl parathion. The pesticides dimethoate, malathion, and sumithion gave similar results. Atrazine, an antagonist of the estradiol receptor, can alter the estruscyclicity in rats and caused lengthening of the estrus cycle and an increase in the number of daysinestrus.

Carbofuran effected the estrus cycle by showing a decrease in the number of estrus cycles and the duration of each phase, which may be due to a direct effect on the ovary or on the hypothalamus-pituitary-ovarian axis causing hormonal imbalance. The pesticide heptachlor may cause disrupted and prolonged estrus cycles. Treatment with DDT and chlordecone resulted in persistent estrus in rats. Lindane induced marked disturbances in the estrus cycle, prolonging the proestrus phase considerablyand thereby delaying ovulation. The pesticideshexachlorobenzene, mancozeb, and 3,3',4,4'-tetrachloroazoxybenzene may also cause cycle irregularities, such as a decrease in the number of estrus cycles and an increase in the duration of diestrus.

Ovulation problems

Endocrine disruptors with estrogenic properties may be able to block ovulation similar to contraceptive pills. The midcycle surge of LH from the pituitary gland provides the physiological trigger for the process of ovulation in the mammalian female. Any agent that compromises the LH surge could function as a reproductive toxicant. Atrazine, for instance, can cause anovulation due to suppression of LH secretion.

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The proestrus LH surge in rats was suppressed after treatment with chlordecone, whereas Muller *et al.* found thathexachlorobenzene can block ovulation in rhesus monkeys. In this study, low estrogen levels were found during anovulatory cycles. The pesticides thiram and sodium N-methyldithiocarbamate may also inhibit ovulation in rats.

Impaired fertility

Human fertility is a delicate process that can be influenced by many factors, such as hormonal imbalance caused by pesticides. However, in most studies it is not clear whether impaired fertility is due to hormonal imbalance or to other toxic effects. Fenarimol was found to cause a dose-related decrease in fertility inrats. Baliger*et al.* found a decrease in the number of healthy follicles and an increase in the number of atretic follicles in mancozeb treated rats. Also, treatment with methoxychlor and chlordecone caused an increase in the number of atretic follicles. This indicates a potential reduction in fertility. A decrease in the number of healthy follicles was also seen after methyl parathion treatment. Exposure to mancozeb and methylparathionmayleadtoadecreaseinuterusweightaswell, whichmayaffectimplantation.

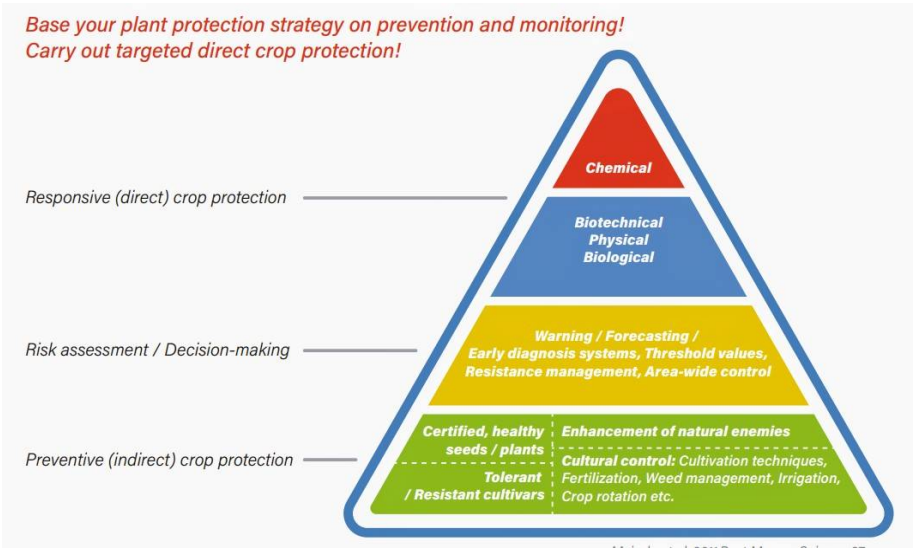
Inhibition of implantation can be caused by mancozeb, methoxychlor, heptachlor, and chlordimeform. Methoxychlor accelerates embryo transport rate in rats and induces pre-implantation embryonic loss, perhaps due to this acceleration. The insecticide lindane modifies sperm responsiveness to progesterone *in vitro*, a physiological effect of the acrosome reaction. Which could be a cause of infertility in women exposed to lindane. Female alligators from Lake Apopka polluted with dicofol and DDT exhibited abnormal ovarian morphology with large numbers of poly-ovular follicles and polynuclear oocytes. Also, their estradiol levels were almost twice as high as in female alligators from a control lake. The investigators suggested that the gonads of juveniles from Lake Apopka were permanently modified in ovo, so that normal steroid-genesis is not possible and normal sexual maturation is unlikely. (Reini W et al.)

2.16 Pest Surveillance Scouting andStewardship:

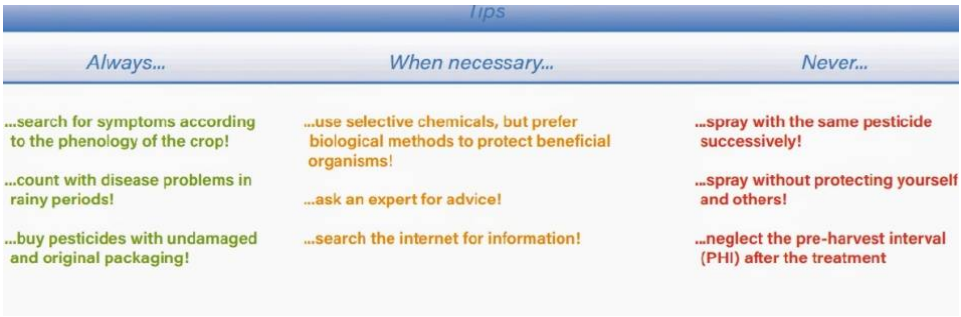
In simple terms, the word _pest' is generally used to describe an -organism that causes serious damage to a valued resource (FAO report, 2017)

The FAO definition of a pest

"Pest means any species, strain or biotype of plant, animal or pathogenic agent injurious to plants and plant products, materials or environments and includes vectors of parasites or pathogens of human and animal disease and animals causing public health nuisance" [Revised 2014: Code of Conduct on Pesticide Management].



2.16. IPM



2.16.1.Insect pest management

Pest management should be part of an overall forest management plan but how individual pests are managed depends on the particular insect and also on the situation (eg. The age of the affected trees). Pest management involves (Phillips C.):

1. ***Knowledge of the insect:*** It is very important to have some knowledge of the insect and its life cycle and biology, whether it is likely to cause significant damage, in which stage is likely to cause the most damage and what time of year it is present in the crop field. This knowledge enables to take decisions to be made on the status of the insect and the risk it poses.
2. ***Surveillance and regular monitoring:*** This is probably the most important part of pest management. Surveillance helps to identify areas where problems have occurred (when damage is detected) or may occur (eg areas of drought stress or nutrient deficiency). It is usually carried out annually, either by air with follow up on-ground or by driving or walking through the field.
3. ***Assessing the risk:*** If an insect pest is detected in a plantation, how does the farmer know whether to be concerned or not? Often the decision to control an insect is made only after significant damage has occurred or large numbers of insects are found in the plantation. Knowledge of the insect and regular monitoring will determine if it is likely to cause damage or not, and whether the population numbers are high or increasing, but how many insects are _too many'? How is the decision made to implement the controlmeasures?

When assessing the risk of damage occurring, it is important to make sure the pest is still present, as it is no use implementing control measures if the insect has already pupated or has flown away. It is also important to know the stage of the pest which is present at the field.

4. ***Control:*** There are a number of different methods that can be used to control or reduce the impact of insect pests.

2.16.2 Stewardship:

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Stewardship is not a theory by itself but there is literature that links different theoretical models to stewardship attitudes and behaviour.

The word ***stewardship*** is used by religious organizations, government agencies, various chemical companies, universities and others. The common use of the word reflects the responsibility for the wise and judicious use and management of natural resources. When it is used in the natural resource managementcontext,ittakesontheconceptof-sustainability, whichindicatesthebalancedaccountof the present society, future generations and other species (Worrell andAppleby,

2000). In its broader approach, this comprises anthropocentric and eco-centric concepts which became the foundation for the biggest applications of the word in forest stewardship council, marine stewardship council and many more natural resource use/management fields to exemplify institutionalized ways to promote responsible behavior among users.

(Hockett et al., 2004) Environmental Stewardship is the concept of teaching young people how to proactively serve their communities as the conservators and protectors of the environment to gift a sustainable future. The specific goals of the Environmental Stewardship program include: understanding ecological concepts, building an awareness of environmental issues and values, developing scientific investigatory and critical thinking skills, and learning skills needed for effective action.

2.16.3 Pesticidestewardship-

The US Environmental Protection Agency (EPA) and the U.S. Department of Agriculture initiated the Pesticide Environmental Stewardship Program (PESP) in 1994 (EPA, 2004). It brought together the pesticide users from agricultural and non-agricultural settings with a goal to encourage stakeholders to voluntarily adopt strategies and management practices to be able to achieve pollution prevention and reduction of risks posed by pesticides to human health and the environment. Unlike the adoption of EPR byEuropeanspartofgovernmentregulationtobeenforcedbylaws,legalenforce

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menthasgenerallybeenavoided in the US in favour of voluntary approaches, reflected in terminology such as ‗product – stewardship which has also been the case for pesticide environmental stewardship programs (EPA, 2004). The voluntary actions in which the pesticide regulators, the industry and educators agree to be engaged includedpesticidecontainerrecycling,certificationofapplicatorsand setting of worker protection standards, formulating pesticide label language and pesticides and the pesticide container disposal options. TheCropLifeInternationalversionofpesticidestewardshipis–*Theresponsiblea ndethicalmanagement of a plant protection or biotechnology product throughout its life cycle to support sustainableagriculture* This definition, however, dilutes the very essence of product-related environmental stewardship in its way of taking the stewardship concept to protect the product rather than the users or the environment. It has a sense of the usual way of promoting pesticides and the plant protection biotechnology without mentioning the –risks and–hazards theymayposeto humanhealth and the environment.

2.16.4 Farmer Field Schools- A way to follow IPMpractices

Farmer field schools were demonstrated to be effective in reducing pesticide dependency in order to protect human health and the environment and also to increase productivity by enabling farmers to follow their farms regularly and act accordingly (Mancini et al., 2007). Moreover, farmer field schools created strengthened social relationships through experiential learning, (Kolb and Kolb, 2012) which gives a chance for farmers to take participatory actions and have dialogues about their pest problems and on how to solve them. The top-down approach of conventional plant protection have left a space for a consultative approach which enabled farmers to present their indigenous knowledge as part of the solution, to listen and try newly introduced techniques and explain what worked and did not work well. Farmers Field Schools are also means of addressing pest management problems by empowering famers to be the experts of their own farms and as a main part of the process from pest management planning to decision making and implementation. Good practices in Asia in the 1980s and 1990s were adopted in West Africa in

1995 (Simpson and Owens, 2002) and in East Africa in 1999. All these experiences show that FFS could be a mechanism to convey IPM techniques which can enable farmers to use their indigenous knowledge, to adopt new alternatives and to consider pesticides as a last resort of pest management options in the crop productionsystem.

2.16.5 Importance and implementation ofStewardship-

Pesticide stewardship is implemented through a network of stakeholders who have a stake in the pesticide sector, agriculture and agro-industry, public health sphere, regulatory processes, information sharing and dissemination, awareness raising, environmental protection and many more. The process can be implemented through various means and venues, including:

- Meetings andthink-tanks
- Training andworkshops
- Electronic communications
- Demonstration trials, actual operations
- Bulletins, fliers,posters
- Awareness rising at vendor, end-user, regulator and inspector levels
- Engaging local and external advisory groups.

Activities that can be carried out through the above-listed methods may involve a variety of issues such as strengthening a PDS will include promoting and ensuring appropriate and adequate packaging,also ensures appropriateness of product labelling and a material safety data sheet in consumers‘ own languages, encores end users to purchase and vendors to sell *only* appropriate types and quantities of products, promoting collection and safe disposal/recycling of the leftover stocks, empty containers and creating an association of national pesticide stewardship networks to help facilitate and strengthen the national PDS.

A well-designed stewardship approach also will enhance the knowledge and skills of the end users. It promotes and ensures the judicious use, handling and management of pesticides. The informed end-

user, vendor, regulator and inspector will avoid counterfeit products that are often associated with health risks and environmental threats. Such practices will ensure equitable access and distribution of products, and also will help to avoid overstocking and wastage of pesticides, eliminate disposal problems, optimize resource utilization and ultimately contribute to human safety, protect the environment, and finally will enhance food security as well as national economy

2.16.6 Strategy and Mode of Operations ofStewardship

Pesticide stewardship strategies are launched and operational zed through various venues. The primary strategy of the stewardship process is to strengthen the existing delivery system in close collaboration with and by enhancing and using the existing technical and material resources. The first line of authority will be the local agricultural experts and other relevant sectors.

The process will strengthen the existing structure. The process would involve multi-tasking and would require multiple years of effort for the creation of a fully-fledged and self-operating system

The stewardship process has wide-ranging beneficiaries and contributors.

While most of the beneficiaries can form a clientele basis for the stewardship process, some can also contribute to the process that is the cornerstone of the national PDS, and among these are:

- Large and small vendors;
- Large and small-volumeconsumers;
- Governmententities;
- Researchers, educators as well as civil societyorganizations.

2.16.7 Principal Goal of Stewardship-

The primary goal of stewardship is to strengthen the national PDS through a network of partners. This will be done to ultimately improve the safety of farms, increase quantity and quality of food, protect the environment, promoteIPM for greater economic efficiency and for maximizing resources.

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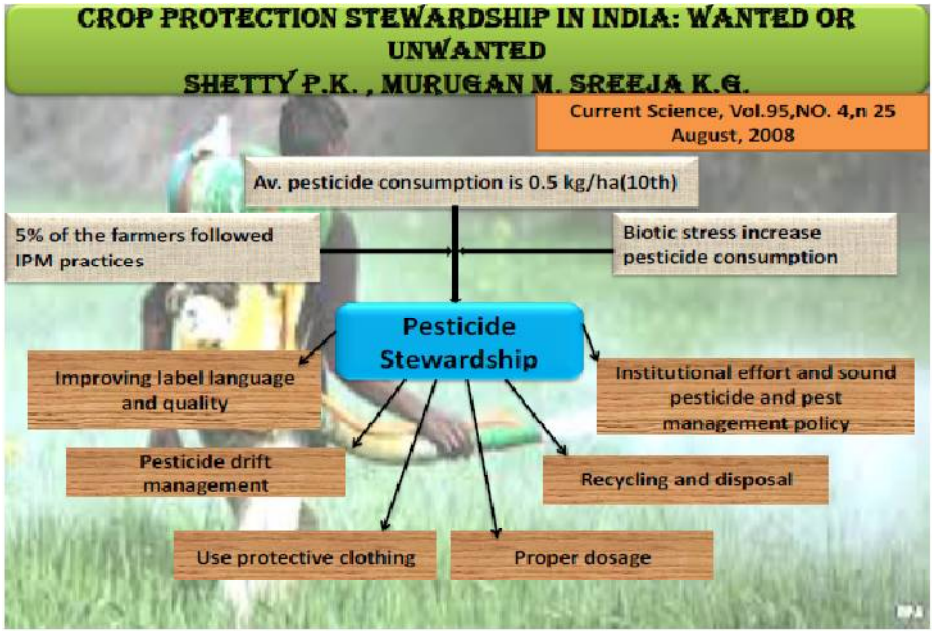
2.16.8 Broader Activities of Pesticide Stewardship-

Pesticide stewardship activities can be broad and include various aspects of the pesticide management and application methods. The stewardship process starts at a well-researched production level where safety and handling aspects of the products are carefully investigated before rolling them out. As soon as the product is off the production line, the marketing component kicks in with force and at times far more aggressively than one could expect. So, monitoring and regulatory processes are much needed from this point on, although they are visible throughout the process. It is critical for the regulatory bodies to fully deploy time at the marketing level as much as in other areas, as the market is key to unfolding many of the existing problems such as the stage where counterfeits and dangerous and illegal products first present themselves to the uninformed buyer.

Decision-making processes and policy dialogue are as important as many other aspects and at times even more so than most basic activities. These processes are key elements to the development stages and survival of sustainable stewardship programs that would require both enabling policy tools and the building of a strong coalition among the core groups, i.e., the national plant protection units, the health and environment experts, food safety entities, industry as well as the advocacy groups, including civil society organizations also.



Now an example of **scouting** will be presented –

During **scouting**, for every beneficial insect they found, the farmers kept a –maize seed and forevery pest they kept a –stone . After sampling three 1m long sections of the cotton crop in the farm, all of the kept maize seeds and stones are counted to determine the collected number of beneficial insects and pests on the crop. If –stones exceed the number of –maize seeds by more than a factor of two, then the farmers apply food spray with soap to attract more natural enemies from the surroundings so as to control pests. When it is thought appropriate, farmers and local agricultural extension agents prepare food spray and apply it to the field. So, a judicious and appropriate pesticide can be applied to the particular crop. It reduces extra application, extra cost and saves human health and environment as well. () Stewardship towards Responsible Management of Pesticides: The case of Ethiopian Agriculture; Sahilu TA)

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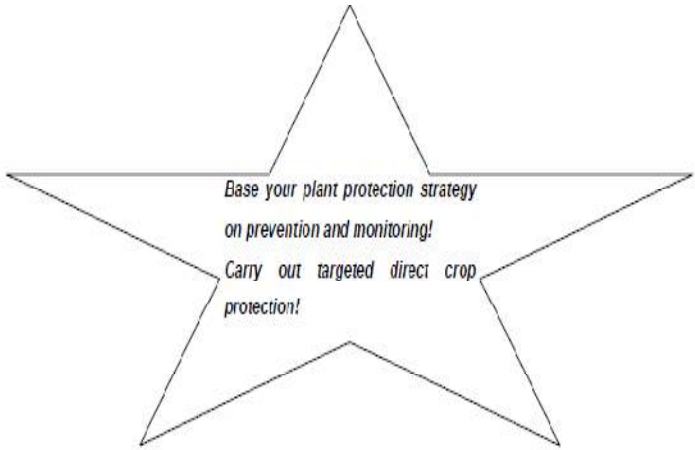
2.16.9 IPM as one of the means to pesticide users 'stewardship-

IPM can be one of the important practices to control pests more effectively and efficiently with sustainability.

2.16.10 FAO Principles on Integrated Pest Management (IPM)

FAO promotes IPM as the preferred approach to crop protection and regards it as a pillar of both sustainable.intensification of crop production and pesticide risk reduction. As such, IPM is being mainstreamed in FAO activities involving crop production and protection. IPM.Developed in response to steadily increasing pesticide. use that resulted in pest control crises (outbreaks of. secondary pests and pest resurgence following development of pesticide resistance) and increasing evidence and. awareness of the cost to health and the environment caused by the intensive use of pesticides.



Integrated Pest Management (IPM) has been known for some decades but is often used and understood in different ways by different people.

- **FAO definition of IPM:**

-Integrated Pest Management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human and animal

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health and the environment. IPMemphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

In other words, all available control options (e.g. cultural, physical, biological, chemical) should be applied reasonably by the farmers.Because, IPM is not simply a toolbox and integration of control options. It also involves measures (e.g. prevention, monitoring, forecasting, early diagnosis) which help to slow down the development of pest populations. An important aspect in IPM is adequate decision making for any interventions. All decisions should be justified both economically and ecologically. Therefore, Management programmes with the regular application of chemicals are not acceptable in IPM. Instead, priority should be given to prevention and alternative control tactics. Principles and more detailed examples in IPM implementations are discussed below:

- **Putting IPM into context**

IPM has been implemented in various regions and countries that are different in terms of their natural and socio-economic conditions as well as their level of agricultural development. But, progression in plant production and protection may be achieved in any existing situations by implementing IPM. The application of IPM is not a simple and strict compliance with rules and regulations, but it rather means actions taken with an environmental approach including principles, strategies and tactics that contribute to the reduction in use of chemicals as well as to higher food security for sustainable production. In order to make IPM as effective as possible, it should be adapted to local/regionalconditions.

- **IPM in a spatial scale: thinking of landscapes instead of individualfarms**

Various types of habitats (e.g. agricultural areas, semi-natural environments) may be identified on a spatial level (i.e. farms, landscapes). They serve as spaces for living, reproduction and overwintering for many living organisms, including pests. Pests can invade newly established crops, spread among different habitats, and build up significant populations therein. The same is true for their natural enemies and antagonists. Thus,

the occurrence and distribution of different species, including pests and beneficial organisms, at a given site will be affected by the surrounding habitats and the management practices applied in these habitats.

- **IPM in a temporal scale: thinking of cropping systems instead of one single Season**

Cultivation of annual and perennial plants host various pests and diseases, and allow the emergence of weeds in the field. In the case of arable crops, the alternation of plant species over time at the same site (crop rotation) may break the life cycle of pests resulting in reduced pest pressure in the subsequent crop. But in case of perennial crops, including orchards, the density of pests in a given year is a major playing factor in the initial infestation level in the subsequent year. So, both crop rotation and/or other pest management measures will thus have an effect on the occurrence of pests in any cultivated plants in a temporal scale. In this context, IPM is the rational regulation of pests, present at the same site, not only in one plant species grown in a given year but also in cropping systems over several years. This approach is also valid and applicable for beneficial organisms. So, IPM should be considered in a spatio-temporal context.

- **General principles for the implementation ofIPM**

1. **Prevention and/or suppression of harmful organisms should be targeted and achieved by the combination of various options such as:**

- Crop rotation andintercropping;
- Use of adequate cultivation techniques (e.g. Seedbed sanitation, sowing/planting time and plant densities, under-sowing, conservation tillage, pruning and directsowing);
- Where appropriate, the use of resistant/tolerant cultivars and standard/certified seed and planting material;
- Providing balanced nutrient supply and optimal watermanagement;
- Preventing the spread of harmful organisms through field sanitation and hygiene measures (e.g. Removal of infected plants, plant parts and plant debris and regular cleaning of machinery andequipment);

- Protectingandenhancing beneficialorganisms(e.g.utilizationof–ecologicalservices insideandoutside productionsites).

2. Monitoring

3.Harmful organisms should be monitored with adequate methods and tools, when and where available. Observations in the field (e.g. occurrence of pests, appearance of symptoms) and, where feasible, scientifically sound warning, forecasting and early diagnosis systems (consisting of traps, weather stations etc.) should be followed. Professional advisors should be consulted frequently. Adequatedecision-making

- Proper decisions should be made about the need for, timing and methods of pest management based on the results of monitoring. Where feasible, threshold limits for harmful organisms should be defined and considering the given growing conditions before any othertreatments.

4. Non-chemical plant protection measures

- Sustainable physical, biological and other non-chemical methods should be preferred to chemical ones especially if they can provide satisfactory pest control. As chemical pesticides are designed to be toxic to living organisms, are dispersed in the environment and are applied to food crops, their use should only be a last option; use when only if there are no adequate non-chemical alternatives and if it is economically justified. If the application of pesticides is foreseen, a pest management plan needs to beprepared.

5. Specific pesticides

- If after the consideration of available IPM approaches the use of chemical pesticides should be justified, then careful and informed consideration should be given to the selection of the pesticides. Factors to be taken into consideration include hazards and risks to users, selectiveness and risks to non-target species, persistence in the environment, efficacy and the likelihood of development or presence of resistance in the target

organism.Thepesticidestobeappliedshouldbeasspecifictothetargetagen taspossibleandshould have minimal effects on human health, non-target organisms (e.g. predators, parasitism, pollinating insects) and the environment (e.g. water, soil). Their use should be kept to a minimum, e.g. by reducing the application frequency or using partial applications. If repeated application of chemicals was justified and required, pesticides with different modes of action (see WHO and EPA toxicity classification schemes) should be applied as part of an anti-resistance strategy to maintain the effectiveness of the available products.

- The products to be applied should be registered in the concerned country, or specifically permitted by the relevant national regulatory authority if no registration exists. The use of any pesticides should comply with all the registration requirements including the crop and pest combination for which it isintended.

6. Evaluation

- The efficacy of the applied plant protection measures should be checked and evaluated based on the records on the use of pesticides and on the monitoring of harmful organisms. This will help farmers to improve future pest management methods by making use of their knowledge and own experience which he/she have gained. In addition to the principles above, key factors for the implementation and development of IPM are the knowledge and capacity of farming communities. Without understanding the local agro-ecosystems, mechanisms, biology of pests and their natural enemies etc., IPM cannot be successfully implemented. Farmers should improve their knowledge by participating in training courses and they should be involved in the development process. Communication, discussion of problems as well as sharing experiences with each other (community-based learning) are also important, and all contribute to proper decision-makingfinally.

  Key benefits of using IPM

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1. Lower risks to human health and the environment (e.g. water resources, pollinatinginsects)
2. Delayed development of pesticideresistance
3. Money can be saved on plantprotection
4. Improved public image of agriculturalproduction

2.17 Government policies and recommendations:

Vector-borne diseases are among the major causes of illness and death in the WHO South-East Asia Region. Chemical control (use of pesticides) is still the most important element in the integrated approach to vector control.

More than 3200 metric tons of active ingredient of DDT (about 80% of the global use of this pesticide), 225 tonnes of active ingredient of organophosphates and about 30 tonnes of active ingredient of pyrethroids have been used annually for vector-borne disease control in the South-East Asia Region during 2006-2007.

As we know, pesticides are toxic compounds and their improper use may pose a risk to human health and the environment. This includes those used in and around homes for personal protection or vectorcontrol.

Based on such concerns, and with the aim to ensure sustainable and cost-effective vector control, WHO published the *Global strategic framework for integrated vector management (IVM).*The judicious use and management of pesticides is a crucial element of IVM and of nuisance pest control.

The *International code of conduct on the distribution and use of pesticides* is the worldwide guidance document on pesticide management for all public and private entities engaged in, or associated with, the distribution and use of pesticides, including public health pesticides. The Code is designed to provide standards of conduct and to serve as a point of reference in relation to sound pesticidemanagement practices, in particular for government authorities and the pesticideindustry.

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The use of substandard pesticide products can result in ineffective pest or vector control operations, leading to increasing application rates and costs. It may also lead to the development of pest resistance to pesticides or aggravate existing problems. In addition, substandard pesticide products may seriously increase the risk to users and the environment as these products may contain impurities/chemicals that can increase the toxicity of the product to humans and other non-target organisms. In 2001, WHO and theFood and Agriculture Organization of the United Nations (FAO) estimated that around 30% of pesticides marketed in developing countries (with an estimated value of US$ 900 million annually) did not meet internationally accepted qualitystandards.

The use of public health pesticides generates various types of waste: leftover pesticides that have become obsolete or otherwise unusable, empty pesticide containers and sachets, and used-up or torn long- lasting insecticidal mosquito nets (LNs). The disposal of pesticide waste is generally not well regulated or organized in many countries in the Region, and public health pesticide waste is no exception in that respect. Such waste is often being deposited in general purpose dumps or littering the environment, which may result in environmental pollution or pose risks to humanhealth.

The prevention of pesticide-waste generation, local recycling of empty pesticide containers, and the environmentally sound disposal of leftover waste all pose great challenges to national governments and require urgent attention.

The *Stockholm Convention on Persistent Organic Pollutants (POPs)*requires Parties to take measures to eliminate or reduce the release of POPs into the environment. With respect to public health, two pesticides are particularly concerned: DDT and lindane.

The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade*2* aims to contribute to the environmentally sound use of certain hazardous pesticides.

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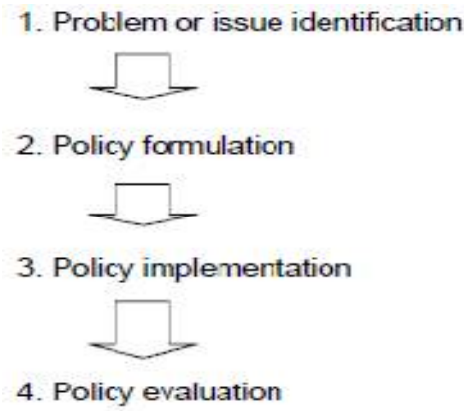
The *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal3* is the global environmental agreement on hazardous and other wastes, including pesticide- related waste.

The *International Code of Conduct on the Distribution and Use of Pesticides4* is the worldwide guidance document and a framework for the management of pesticides, for public and private entities engaged in, or associated with, the distribution and use of pesticides, including public health pesticides.

Adopted by the 1st International Conference on Chemicals Management (ICCM) in 2006, the *Strategic Approach to International Chemicals Management* (SAICM)5 is a policy framework to foster the sound management of chemicals throughout their life cycle, by 2020.

The **basic policy cycle** consists of four steps, as outlined schematically below.



2.18 Nutrition and Health:

Women invariably perform the duties of both the workers and the housewives. This dual role entails serious mental and physical effort which often results in complete exhaustion of women because of over work. Healthiness could be a demand throughout life and too much important to women in terms of their daily activities. However, nutritional anaemia is a

major problem for women in Indian sub-continent. To beat these issues daily diet of the women should be wholesome. But health is a crucial aspect where no due attention has been paid for the women.

But majority of women in rural India is associated directly or indirectly with agricultural activities. About 2/3 rd. of the manual labour in farm work is constituted by the rural women. Irrespective of their degree of affluence, rural women provide 14 to 18 hour of productive physical labour every day in a variety of activities directly connected with agriculture, allied and domestic chores. Though some nutritional surveys conducted across India indicate considerable gaps in nutritional requirements and consumption among females as compared to males. And majority of rural and tribal women suffer from anaemia which often leads to low birth weight amongbabies.

As we know, the requirement of food of the people varies greatly due to various factors. Apartfrom non-occupational activities, the energy requirement changes also depend upon the various activities that one has to perform as his or her daily work such as agricultural activities, working as a labour in MGNREGA, etc. And a considerable percentage of India's population consists of agricultural workers, out of them a good percentage is constituted by the farm women. But their nutritional status, nutritional requirement do not come into the light which is highly related to their health, to their wellness.

Because, we know that health is fundamental to human progress. So, Women's health status also affects their productivity and thereby their roles in society and their own development. Then low nutritional status of woman makes her more prone to several diseases. It has notifying significance in case of women, because they have to bear and rearchildren.

2.18.1 Calorie and ruralhousehold

Calorie is the unit of energy which helps one to bear his daily life. Calorie intake is done through the consumption of mainly carbohydrate, protein and fat and other essential elements. Below a table is given to show the standard mean calorie consumption per capita per day.

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Table 2.18.1: Mean Per Capita Consumption of Calories, Protein, and Fats (per day): Source: NSS data

		Calories (kc)		Protein (gms)		Fats (gms)	
Year	Round	Rural	Urban	Rural	Urban	Rural	Urban
1983	38	2,240	2,070	63.5	58.1	27.1	37.1
1987-88	43	2,233	2,095	63.2	58.6	28.3	39.3
1993-94	50	2,153	2,073	60.3	57.7	31.1	41.9
1999-2000	55	2,148	2,155	59.1	58.4	36	49.6
2000-01	56	2,083	2,027	56.8	55.3	34.6	46.1
2001-02	57	2,018	1,982	54.8	54.2	33.6	46.1
2002(2)	58	2,025	2,014	55.4	54.9	34.7	47
2003	59	2,106	2,020	58	55.5	36.4	46.7
2004(1)	60	2,087	2,036	56.9	55.9	35.5	46.8
2004-05	61	2,047	2,021	55.8	55.4	35.4	47.4

But, in rural India, household per capita calorie consumption was 2,240 calories in 1983, 2,233 in 1987-88, and had fallen to 2,047 calories per head in 2004-05, a decline of 8.6% from 1983; and in case of urban per capita calorie consumption was only 49 calories (2.4%) lower in 2004-05 than in 1983. Over the same period, rural (urban) per capita protein consumption fell by 12.1% (4.6%). Only per capita fat consumption has raised.

2.18.2 Nutrition Status of Women in India: AnOutline

National data (NFHS-1 1993, NFHS-2 1999, NFHS-3 2006, and CES, 2009) reveals that percentage of women with low body mass index (BMI) has remained almost same in the last two decades inspite ofimprovement in provision of maternal health services, including institutional delivery which has increased significantly (shown in Fig1). As per the national data (NFHS-

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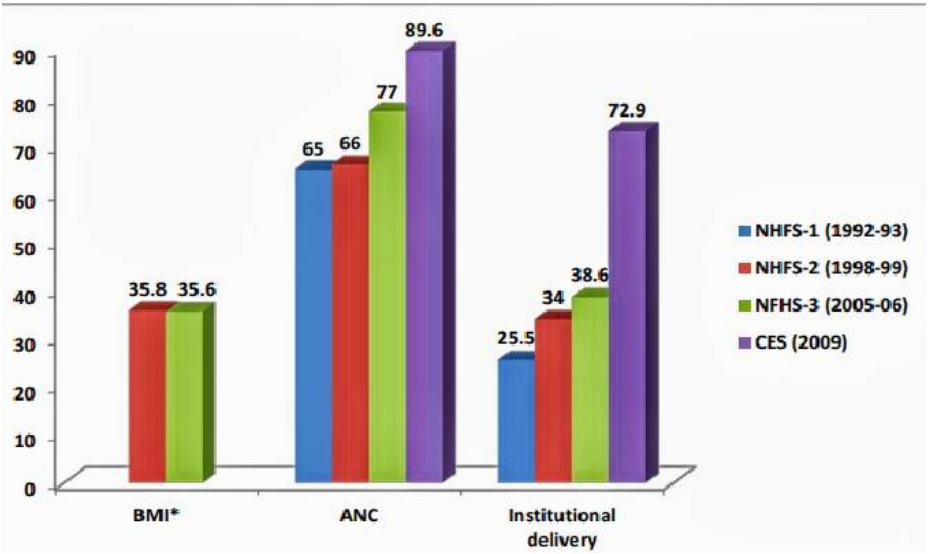
3, 2005-06), over a third of women are reported to have low BMI and face under nutrition is almost same since 1998-99 (NFHS-1, 1993).



Source: Adapted from (NFHS -1 1993, NFHS-2 1999, NFHS -3 2006)and coverage evaluation survey (2009)

Figure 2.18.2.1.: Trend in maternal nutrition and health services

Here, wide state-wise variations in the rate of under nutrition in women (shown in fig 2) have presented. According to the last national survey, 13 states in India have depicted a higher percentage ofmothers with low BMI compared to the national average of 35.6 percent (NFHS-6, 2007). A study of state-wise situation between NFHS 2 and NFHS 3 reveals that there has been a substantial decline in under nutrition in women in five states- Mizoram, Meghalaya, Manipur, West Bengal andOdisha.

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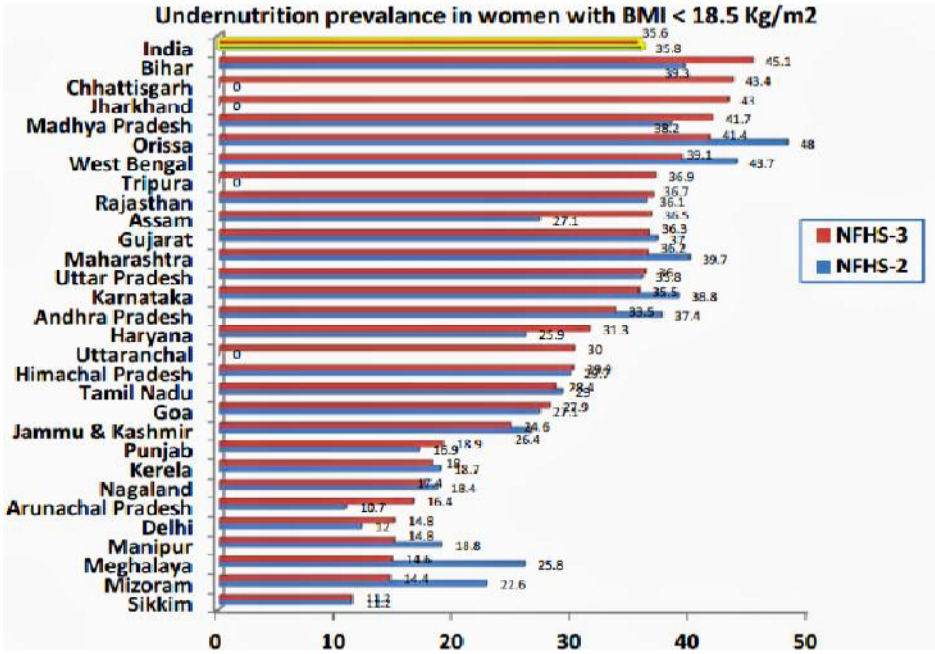

Figure 2.18.2.2: State-wise prevalence of Under nutrition in women in 1998-99 and 2005-06 Source: NFHS (2007)

It has revealed from the NFHS data that the rate of under nutrition in women is much higher in rural areas (40.6 %) compared to urban regions (25 %).In the present study, the main concern is for rural women, more specifically farm women. The under nutrition rates in women in low wealth index is almost three fold higher compared to highest wealth index (figure 3). Moreover, unlike Nigeria and Ethiopia, a substantial and sharp decrease in undernourished rate of women is observed in India with increase in wealth quintile. This highlights the significant equity issue which needs to be addressed.

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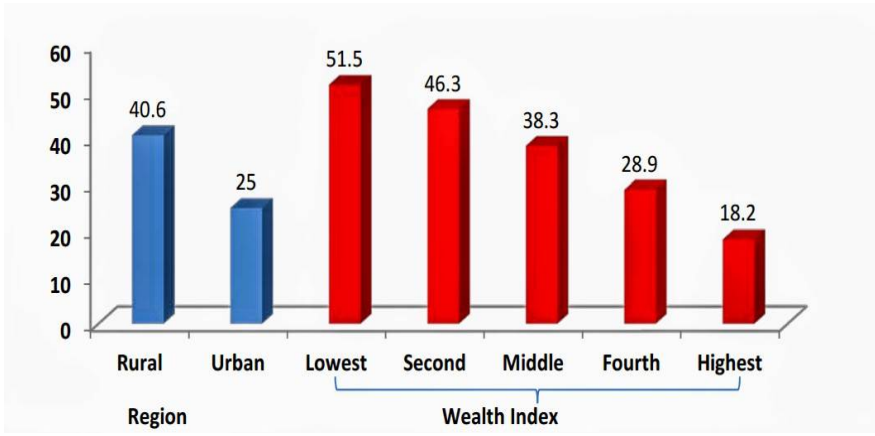

Figure 2.18.2.3: Undernutrition (BMI<18.5) in women in India by region and wealth quintile Source: NFHS-3 (2005-06)

2.18.3 Anemia: A never-endingissue

Anemia is prevalent across all age groups— about 70 percent young girls below 5 years, 55.8 per cent adolescent girls, 56.2 per cent women in reproductive age group and 58.7 per cent pregnant women are reported to be anaemic. State-wise anaemia prevalence rate in women 15-49 years is higher than the prevalence rate of 40 per cent, anaemia being a severe public health problem, in all the states of India except five states (Table 1) (NFHS-3, 2006).

Percentage Prevalence of Anaemia	States
< 40% (5 states)	Punjab, Manipur, Mizoram, Goa, Kerala
> 40-60% (16 states)	Delhi, Haryana*, Himachal pradesh, Jammu & Kashmir, Uttaranchal, Chhattisgarh*, Madhya Pradesh*, Uttar Pradesh, Arunachal Pradesh, Meghalaya, Sikkim, Gujarat, Maharashtra*, Karnataka, TamilNadu
^60% (7 states)	Bihar*, Jharkhand*, Orissa*, West Bengal*, Assam*, Tripura*, Andhra Pradesh*

All India anemia prevalence is 55.3%.

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Anaemia prevalence rate is almost similar in all sections of the country.As we know, at the time of pregnancy the demand for iron and other micronutrients highly increases. There is almost a ten- fold increase in iron requirements by the third trimester of pregnancy. Most of the local diets fail to meet such higher needs of iron. The data of the National Nutrition Monitoring Bureau (NNMB) reveals that in rural India, only 23.0 percentage adolescent girls, 15.2 per cent adult women and 9.6 per cent pregnant women consume over 70 per cent of the recommended dietary allowances (RDA) of iron (NNMB, 2012). The main source of iron is from cereals in Indian diet which is high in phytate reduces the availability of iron consumed.

As in case of anaemia, the primary cause of under nutrition in women lies in inadequate consumption of energy, proteins and fats. The NNMB 2012 data pooled from ten states indicates poor intake of nutrients during adolescence and prior to onset of pregnancy and during the period of pregnancy. In 10-12 years girl, except for cereals, consumption of pulses and legumes as well as vegetables, milk and fat is very much low.

2.18.4 Sources of Protein and other elements in women's daily diet:

Protein consumption seems to be high but the source is primarily cereals which provide poor quality protein. No gender difference is observed in consumption of nutrients in boys and girls. The RDA for iron is high in girls and therefore the intake of iron in terms of Percentage of RDA is rather low in girls compared to boys.

According to the NNMB 2012 data, consumption of mean energy and protein is almost identical in pregnant (1773 Calories and 49 grams protein) and adult non-pregnant women (1709 and 47 grams).But only 61 per cent of pregnant women report consuming over 70 per cent of the recommended dietary allowances (RDA) of energy while only 30 per cent consume over 70 per cent RDA of protein. No notable increase inintake of vitamin A and calcium is observed during pregnancy with less than 10 per cent consuming >70 per cent RDA of calcium while only 13 per cent reported to be consuming >70 per cent RDA of vitamin A (NNMB, 2012).

Poor dietary intake combined with excessive energy expenditure due to high levels of daily physical activity, related to agriculture and domestic activities in India has been reported to influence maternal nutrition with adverse impact on birth weight. A direct relationship between maternal physical activity and birth weight has also been reported). Working in farms, fetching fuel wood and water are other activities by women are energy consuming and have influence energy balance with significant negative impact on preventing weight gain also may have adverse impact on birth outcomes. Moreover, farming activities have a seasonal energy stress onwomen depending on lean or harvesting period of farming with its impact on energy balance and impact on pregnancy outcome.

Besides poor purchasing power and low consumption of diversified food, factors like early marriage, pregnancy at young age of below 20 years, women entering pregnancy with poor nutrition and poor knowledge of self- care play a central role in maternal under nutrition. Teenage marriage and conception at the early age of 18 years is a major cause of under nutrition in women. In India, percentage of women 15-19 years who have begun child bearing is 16.0 per cent. Of these, 2.5 per cent are reported to have begun child bearing at 15 years while 42.9 per cent are reported to have begun child bearing between 16-18 years and 35.7 per cent of by 19 years of age (CES, 2009). The proportion of women age 15-19 years who have begun child bearing is more than twice as high in rural areas (19 per cent) compared to urban areas (9 per cent).

Poor educational status of the women: Causes of poor health and nutritional aspectsPoor education and knowledge of women, low status in society, inadequate decision making power is some of the important causes which results in poor maternal health and nutrition situation. An analysis of the National Health and Family Survey-3 (NFHS-3) data reveals that with increase in level of education of women, there is reduction in percentage of adolescent marriage, increase in mean age of first birth, decrease in spousal violence as well as decrease in percentage of women with low BMI (shown in figure 5)

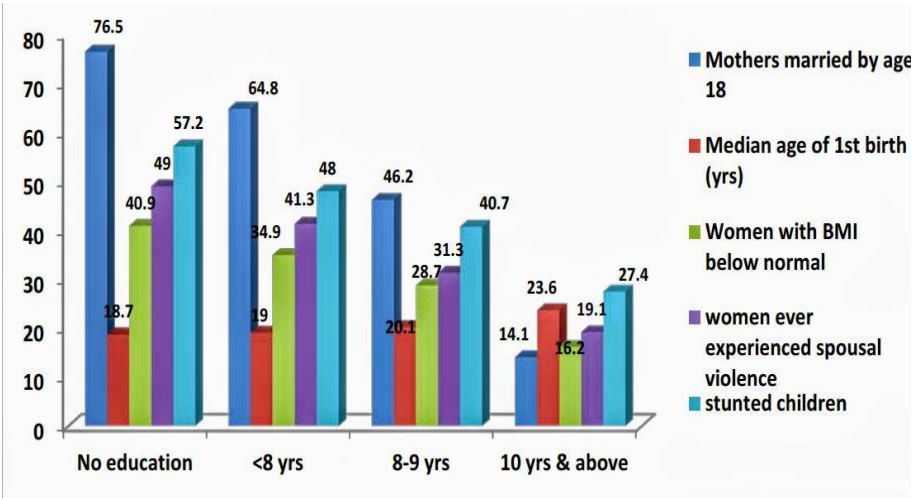

Figure 2.18.5: Women's education and trend in maternal factors and stunting in children Source: NFHS -3 (2005-06) and NNMB Survey (2012)

2.18.6 Addressing Women's Nutrition: AChallenge

Interventions for improving women's nutrition caught attention in 1998 when the conceptual framework of under nutrition in children positioned maternal nutrition as an important underlying cause and stressed on breaking the inter-generation cycle of under- nutrition. In recent years, the need to concentrate in the first 1000 days of life for prevention of under-nutrition has been emphasised. In 2008, along with promotion of infantand young child feeding practices, improving nutritional status of women and adolescent girls been included in the set of selected high priority direct essential nutrition interventions proposed for reducing under -nutrition rates in children in developing countries. These global guidelines were further contextualized with reference to India's nutritional epidemiology and a list of ten nutrition interventions was proposed by the Nutrition Coalition of India which include actions for improving nutrition of adolescent girls and pregnant women. The interventions refer to prevention of anaemia and iodine deficiencies in adolescent girls and women as well as provision of food supplements to disadvantaged women. Policies for these interventions have already been issued by the two nodal ministries of the Government of India—Ministry of Health and Family

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Welfare (MHFW) and Ministry of Women and Child Development (MWCD). The micronutrient programmes are managed by MHFW while provision of food supplements as supplementary Nutrition Programme (SNP) to meet one third of energy and protein requirements of pregnant and lactating women has been a part of the ICDS programme of MWCD since its inception in 1976. Policy guideline regarding composition and cost of the supplementary food has undergone a number of changes in the last four decades. The food supplement policy of ICDS has also shifted from targeted pregnant and lactating mothers approach to universal coverage. However translating policy into action has been rather poor with less than a quarter of women reported to be receiving supplementary food (NFHS-3,2006).

Other initiatives launched in the last five years to improve the health and nutrition situation of women are with reference for improving health and nutrition of adolescent girls. The Adolescent Reproductive Sexual Health (ARSH), the adolescent health programme of MHFW and Rajiv Gandhi Scheme for Empowerment of adolescent girls (RGSEAG) or SABLA programme of MWCD. These programmes offer opportunity to improve nutritional status of adolescent girls. ARSH aims to educate youth about their sexual and reproductive health and the availability of youth-friendly services to encourage them to access health services SABLA programme is being implemented in 200 districts in India (NRHM 2006). Additionally, the Weekly Iron-Folic acid Supplementation (WIFS) programme, launched as pilot projects in a few states of India in mid- 2000, has today been scaled up in the entire country by the MHFW. Deworming at 6 monthly intervals is a part of the WIFS programme guidelines (WHO, 2010). The model of WIFS programme also exists for adolescent girls enrolled in government run schools and for non-school going girls. Out of school adolescent girls is attained through the ICDS programme.

The dietary intake and weight gain remain also low priority. (Incomplete Reference, 2012). The launch of the Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A) approach by the Ministry of Health and Family Welfare is a confirmation of the significance now being attached by Government of Indiato continuum of care approach

in the development of state, district, block and panchayats plans of action (NRHM, 2013).

A few interventions, like provision of only folic acid supplement in the pre-conception period have been included for the first time in a programme inIndia.

In the past two years, a new initiative*Indira Gandhi MatritvaYojna*(IGMSY) for pregnant mothers has been taken in 52 selected districts across the country by the Department of Women and Child, as a part of the ICDS programme (IGMSY, 2011). The Scheme is designed to address socio-economic problems of pregnant women. The 12th Five Year Plan of the Government of India aims to scale up the IGMSY scheme in the entire country and is included as a component of the Food Security Bill (National Food security Act, 2013).

Besides, JananiSuraksha Scheme (JSY), a conditional cash transfer scheme, reveals a significant effect on increasing antenatal care and in-facility births with an effective reach and coverage of BPL families (Lim et al., 2010) and it also offers a platform to reach the poorest and most disadvantaged women with improved coverage and quality of ANC services, including counselling on diet, weight gain monitoring and IFA consumption.(Vir SC et al.)

2.19 What isEducation?!

Education, a powerful instrument of social, economic, political and cultural changeand it holds the power to give strong impetus to national development. Though in the long run process of development, the role of education is to impart knowledge, understanding, attitudes and skills to human resources and but in turn education makes these resources qualified to utilize the physical resources fully andeffectively.

We know, education has a strong relation also with the human resource of the country and women are the half part of it..And a major part of the women community in India suffer from a lot of severe physiological and psycho-social problems, in the present study, more specifically the farm women who reside in the rural India. Thus, we will try to find that whether there is any relation between the education and

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health exists or not and to what extent this is affecting the farming community!

So, before discussing the relation of health status of women with the education, at first, we should throw a light on the present status of the rural women:

- Women represent half of the world's population and contribute 2/3 rd of the total work, but receive only 1/10 th of the total income.
- Rural women contribute about fifty per cent of total food production but receive little or no agricultural training of any kind.
- Women spent longer hours than men from 15 to 19 hours a day. In addition due to looking after the children, they do the housework, fetch firewood, carry water, prepare foods and perform the laborious jobs like hoeing, planting and finally the harvesting of field crops.
- But it is irony that in most of the regions in the world, maternal mortality rates are still high, women are suffering from chronic malnutrition, and 2/3 rd of them are anaemic.
- Ignorance of a more balanced diet, to family planning and to hygiene in the home and to other ways of improving family health, above all the quality of life, is partly the result of illiteracy among them.

2.19.1 But, what are the effects of this education or literacy onhealth?!

Education is strongly linked to health and to the determinants of health such as healthbehaviours, risky contexts and preventative service use.

Education does not act on health in isolation from the other factors.But, income is also an important factor that interacts in many important ways with education having an influence on health. This makes it hard to assess their independent effects. However, some empirical investigations often find that the effect of education on health is as great as the effect of income.

Those with more years of schooling tend to have better health and well-being and healthier behaviours. Because education is an important mechanism for enhancing the health and well-being of individuals because

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it reduces the need for health care, the associated costs of dependence, lost earnings and the human suffering. It also helps to promote and sustain healthy lifestyles and positive choices, supporting and nurturing human development, human relationships and personal, family and community well-being.

Finally, although education appears to be protective against the depression also. It is also important to emphasize that to the extent that education effects on health occur as a result of impacts on features of the self, particularly self-concepts and attitudes, then if the quality of education is not appropriate to the developmental needs of the individual education can have directly injurious effects.

For example, there is good evidence that beliefs about health and health care, shaped and influenced by socio-demographic factors viz. Education which determine health behaviours. But it has found from some studies that education has the potential to change health beliefs and behaviours if designed and delivered to appropriately address particular notions about health andillness.

In relation to the workplace and working conditions, education reduces the likelihood that individuals will work in the most hazardous jobs. As well as this direct effect of physical hazards, education impacts. on social and economic relations in the workplace to improve the relative health of those with autonomy and authority in the workplace and reduce that of individuals with less. Autonomy and authority. There may also be an aggregate effect by which increasing average levels of education may improve the overall balance of risk through these channels.

The health productivity of learning requires more attention from policy makers than it has hitherto received. This is not primarily a question of providing more specific health-based learning but of recognizing and investing in the wider impact of general learning in education contexts through the life course.

Indicators, which will be used in the model, could usefully be developed in relation tothe relationships between educational level and one or two key indicators of health behaviour such as smoking and or a

measure of psycho-social development such as self-esteem. These indicators would provide useful information for national policy makers about the extent to which education and health systems compare internationally in the harnessing of educational productivity in the service of health outcomes and about the genesis of health and well-being.

There is considerable need for more evidence that can draw a wider range of measures of educational provision and addresses the more qualitative aspects of education such as pedagogy, learning ethos, teaching style, and the relationship of learning to the self-concepts and the personal development of learners.

But the economic returns to education are relatively easily understood as the result of the human capital formed in the education process. The health effects of education are much broader in scope, reflecting a much wider set of outcomes with an equivalently wider set of mechanisms. Human capital is an important channel but other personal resources are also important. In the models discussed below, it is highlighted that social and/or capital identity is important mechanisms by which health benefits are generated. These capitals are not the same as human capital and not reducible to it.

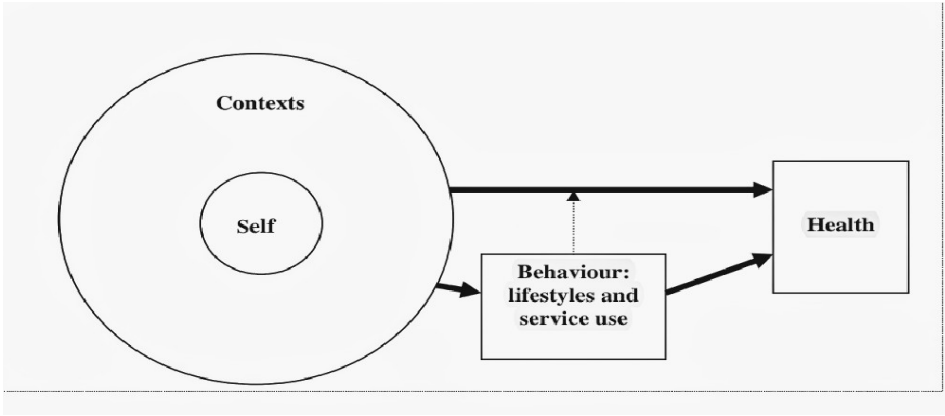

Figure. 2.19.1: Basic conceptual model of influences on health

It is found in found in **Bronfenbrenner's ecological Perspective.** The central idea is that individuals exist in multiple, multi-layered and

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interacting contexts, each of which is a domain of social relations and environmental health risk and protection. The social relations in each context include some elements of structure. So that in each context the individual experiences bounded agency that in different ways at each level may be important in the formation of health outcomes.

The model as presented in the Figure is fairly static in that it holds constant many important dynamic and lifelong processes. This is useful in focusing on the core issue of the effects of the self-in-context on health which will be manifested in part via health behaviours. For many aspects of health these effects can take a very long time to emerge.

Health disparities are much more apparent in older age than in the mid-adulthood, particularly for physical health outcomes. There are also important reverse mechanisms, impacts of health and of health behaviours on the self and on contexts. Individuals hold a degree in the determination of their mental and physical health. But this agency is bounded by structures and contexts and by features of the self that constrain healthy choices that in other terms may seemrational.This—irrationalityliesattheheartofthepublichealthproblem.

2.19.2 The role ofeducation

We introduce education into the model in Figure2. At the centre of the framework is the self in context. It can be seen that education matters to health primarily through direct effects on the people that engage in it and secondarily because it has impact on the choices of contexts that people come to inhabit or on their opportunities to choose such contexts. Also, through effects on multiple individuals and on social relations and wider socialisation and civic processes, education has the potential to fall impact on the nature of the contexts themselves, changing workplaces, homes, communities and wider society. It is important to remember that context have defined in a very general way that includes environmental health and social and economic relations. Although education has this potential, little is known in quantitative terms about the precise nature, range and magnitude of sucheffects.

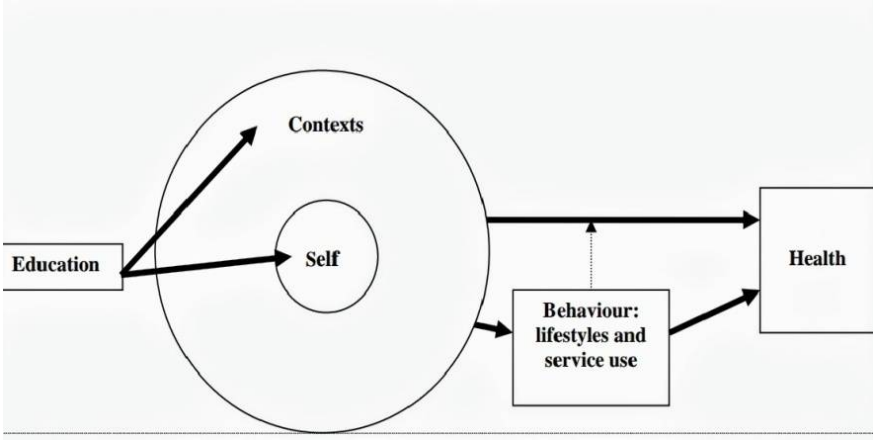

Figure 2.19.2: Basic conceptual model of the effects of education on health

The figure 2 has emphasized also emphasised that the self and contexts are constantly in interaction. This interaction of people and contexts is the basic to the ecological, self-in- context model and is crucial in the generation of health outcomes. The effect of education is not a one-off impact that leads individuals into given contexts. The benefits of education are more dynamic.

Through benefits of education for individual and community agency, education may continue to moderate the effect of contexts on the individual, providing protection against the stresses and health impacts of risky environments.

To the extent that education supports these features of the self, it enables and empowers individuals to protect their health and manageill-health.

2.19.3 Healthliteracy

The significance of the global health risk factors has led to a major emphasis in public health policy on education interventions. This role for education has traditionally focused on providing information and skills to help people make choices and/or changes that will promote individual and societal health and well-being. Contemporary health education had three

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main aims: to reduce morbidity and mortality through changing the behaviour and beliefs of individuals; to foster the appropriate use of health services; and to create general awareness of health issues.

Policy makers have historically designed specific health promotion programmes that, through health education, put the onus on individuals to change behaviours that lead to ill health.

Health promotion has shifted toward addressing the contextual and social as well as the behavioural determinants of health. Health policy, thus became concerned with creating supportive contextsthat make –the healthy choice the easychoice . As such, pervading all policy is the ultimate goal of reducing inequities, furthering human rights and building social capital – an approach which addresses the social determinants of health. Health education hasalsomoved toward the adoption of a –life-skillsapproach through raising consciousness about factors that influence health and increasing the ability for individuals to make informed choices through fostering empowerment. These modelsof health education aim to encourage personal growth through enhancing awareness, self-esteem and self-assertion.So,themovementtowardlifeskillsencourageshealthliteracy;ashifta wayfrom the simple transfer of information, toward the development of self-esteem and confidence that allow individuals to make educated choices about their health and seek out more information if necessary.

The World Health Organisation has defined health literacy as:

"…the cognitive and social skills that determine the motivation and ability of individuals to gain access to, understand, and use information in ways that promote and maintain good health. Health literacy means more than being able to read pamphlets and successfully make appointments. By improving people's access to health information and their capacity to use it effectively, health literacy is critical to empowerment."

So, developing health literacy is about nurturing the benefits of education and learning that extends beyond the acquisition of information toward overall personal growth.

2.19.4 Beliefs about health and healthcare

In terms of health and health care, beliefs are important because they drive behaviours that have implications forhealth outcomes. This relationship is illustrated in the Health Belief Model. This model suggests that individuals will take action to protect themselves from disease and injury if a particular set of beliefs is in place about their position with respect to a condition. Components of the model include perceived personal susceptibility to an illness or ill-health condition, an understanding of the severity of a given illness, a position on the benefits of a course of action and a calculation of the barriers (or costs) versus advantages of any health-relatedbehaviour.

Perceived susceptibility is the subjective measure of risk to contract a healthcondition. It is the individual‘s understanding of a diagnosis or the probability of him/her falling in illness. For example, before attending a screening for cervical cancer, a woman must believe that she is vulnerable to the disease. In addition to perception of vulnerability or risk, an individual‘s opinion of the consequences of becoming ill or leaving an illness untreated also partly determines her decision to take action. Using the example of cervical cancer screening, a woman‘s perception of the extent to which developing cervical cancer will be physically or socially influencing will have an impact whether she will attend screening or not. Additionally a sense of the benefits of a suggested action is important for health behaviours. A woman‘s belief in the efficacy of cervical cancer screening in reducing susceptibility and severity or perceived threat of cervical cancer is implicated in her attendance. An understandingofthenegativeaspectsofanypotentialactionalsoweighs upon thelikelihoodof engaging in health behaviour. According to this approach, largely unconscious calculation of the relative cost in time, energy, money, or psychosocial costs, such as distress, precedes any action. A consideration of the benefits of learning about health may or may not be seen as advantageous depending upon the potential financial or social implications of attending screening.

Evidence for the potential for prior beliefs about health to influence decisions about behaviour is found in a study using focus groups on

parent's beliefs about child immunisations. Evans *et al.* (2001) found that parents' lack of confidence in health professionals is in some part due to their knowledge that health professionals have to reach targets for vaccination in order to be paid. Therefore, the advice of health professionals is not seen as beneficial for the child, but rather as self-interested. Further, lay beliefs about health often compete against attempts to educate populations about the benefits of particular health behaviours.

So, beliefs around health and individual level of control over their health were linked to socio-demographic factors, such as educational attainment, gender and ethnicity that were not sufficiently taken into account in the design and delivery of health promotion activities.

Above all, education have the potential to act as an initial source of information about health and health care, but is also important in triggering cues to action through the provision of new information in health promotion activities. Targeted and tailored health education that addresses both the beliefs that precede actions and the varied socio-demographic and cultural sources of beliefs can insist actions around health.

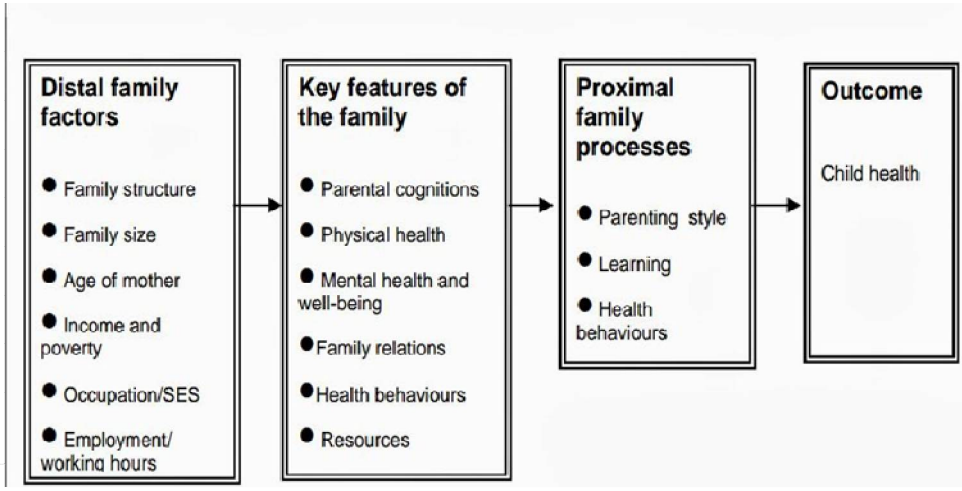

Figure 2.19.4: Conceptual model for the related family influences on child health

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The final category is family process. By the term _ process _ we refer to the actual interactions experienced by a child. Process is the most proximal element in the model as it refers to the day-to-day life of the child. Examples of family process variables include the type of nutrition in the home, the story of parent-child relationships such as warmth, affection and love which are important in the formation of the child's self-concepts and resilience – and the use of discipline, control and punishment strategies. So, in early stage the family context is particularly an important context for developmental health and strong mechanisms of inter-generational effects of education also takes place.

2.19.5 Work and occupational health risk

The evident link between education and occupation is the increased access to work that does not compromise physical and mental health. In general, higher levels of education lead to non-manual labour occupations where dangers to physical health through exposure to injury or dangerous chemicals are reduced. Additionally, as emerged from the Whitehall studies of British civil servants, the mental and physical health implications of occupations are related to the balance of demand and control. In particular, jobs characterised by low control were associated with increased levels of sickness. The Whitehall II study demonstrated that this relationship was independent of individual characteristics.

Hazards faced in the work environment have serious implications for health accounting for 1.5% of the global burden in DALYs. Potential hazards vary broadly from exposure to chemicals to adverse ergonomic conditions. These exposures increase the risk of a number of health outcomes, including injuries, cancer, hearing loss, respiratory, musculoskeletal, cardiovascular, reproductive and psychological disorders (WHO,2002).

Work-related injuries are another important source of occupational hazard. The highest risk is found among industrial and agricultural workers.. Data have demonstrated that overall each year 310 000 employees die as a result of unintentional occupational injury.

Examples include injuries among health care workers resulting in the contraction of infection, falls and poisonings. Occupational injuries are responsible for 0.9% or 13.1 million of global DALYs (WHO, 2002).

Nearly 1.4 million DALYs are attributable to exposure to carcinogens in the work place. Occupational exposure to chemicals such as, asbestos, arsenic, beryllium, cadmium,chromium, diesel exhaust, nickel and silica account for 1.3% of cancer of the lung, trachea and bronchus and 2.4% of leukaemia diagnosed, worldwide. The chances of developing a related illness depends upon the dosereceived, potentiality, interaction with other present carcinogens, and individual susceptibility. The attributable mortality to exposure to carcinogens amounts to 146 000 (0.3%) of deaths (WHO, 2002).

Stress is the number one cause of lost time at work. Stress experienced in the work place has been linked with coronary heart disease. Key elements of work environments that produce large amounts of stress like high psychological demand combined with low decision making power and control that has become typical of positions management and administration among other roles. This is too much common in case of rural farm women. A further stressor linked with disease is shift work. Employees working in shifts tend to be exposed to heavier workloads, higher demands, poor psychosocial work environments, reduced physical activity, limited control and are less educated. Also fatigue and disturbances in the circadian rhythm are associated with stress-related coronary heart disease (WHO,2002).

2.20 The measurement of education

Education is generally defined in terms of the number of years in which an individual has participated in schooling, or sometimes in terms of the level of qualifications attained. Both of these measures are important and relevant to the study of education effects. But, the conceptual framework highlights that some of the mechanisms for effects of education are to do with the nature and quality of the education or learning experienced.

So, Education has substantial effects on health that provide personal and social benefits, not captured in the calculation of the personal wage benefit of education.

These benefits accrue to individuals, families, communities and nations.

- Educationisimportantintheformationofhealthnotjustbecauseithaseffect sontheIndividual but also because it impacts on the access of the individual to relatively healthy contexts in terms of physical/chemical environments and social and economic relations.
- Theimportanceofeducationforhealthisnotjustamatteroftheaccessofthei ndividualtoeducational provision but also of the social level of access. As the social level of access changes so will the individual levels of benefit.
- There may be very important externalities from the education of some to the health of others.

The effect of education on health is substantial and substantive. It feeds into in- equalities in health as well as to average levels of population health. Wide-ranging, different aspects of health, well-being and health behaviour are impacted on by education and there are also effects on the next generation. Education is not just a marker of genetic capabilities or personal agency and well-being but has independent causal effects that have been replicated across many studies in many different contexts.

2.21 Expenditure in education

If education has private and social benefits of the kind indicated above then there is a basis for the view that expenditure on education is too low. This would follow if the public and private funders of education were making choices about funding and participation on the basis of a calculation of its wage, employment and economic benefits without considering the value in terms of improved health. Failure to recognise this additional benefit may lead to under-investment in education and to unnecessary personal and social costs in terms of ill- health and reduced well-being. It may also be that some individuals and governments do

implicitly recognise the range and scale of potential benefits from education and so do factor these wider considerations into their funding and participation decisions. We hope that this review can provide useful information so as to enable more informed assessment of the health benefits that may accrue from learning and education.

The conceptual analysis in this report suggests that not all of the health benefits of education occur at the individual level. Some of the effects of education may be experienced in terms of improvements to social support, to the tensions in social and economic relations in the workplace and other contexts and in overall improvements to environmental factors such as through reductions in polluting technologies in line with skill-biased technological change. Many of these potential types of benefit are externalities in the sense that the benefit is accrued by social groups or society as a whole and so are ignored in the calculation by individuals of the benefit to them ofeducation.

Externalities of this kind are the basis for public investment in the perspective of classical economics.

2.22 Mental health andwell-being

Now, the links between education and mental health and well-being will be discussed.

Educational effects are different in these domains. As indicated by Bynner, Woods andButler (2002), women with higher levels of education are less likely to be depressed but also more likely to have lower job satisfaction. In this sense, these women are not achieving what they would like in the labour market, but their education still has important protective elements against the risk of depression.

Depression is considered as an indicator of mental health conditions. There are several reasons why depression is exclusively focussed.Primarily, other mental health conditions such as schizophrenia, mental retardation, autism and, ADHD, have low prevalence among the farming population. Depression is a common form of psychological distress experienced by everyone at some time to some degree and it correlates with other forms of distress such as anxiety and anger. Secondarily, developments on

measures for detecting mental health disorders have traditionally not been as advanced as those for physical health. Further, cultural stigmas associated with mental health disorders prevent individuals from seeking treatment (WHO, 2003). Finally, causes of depression are both biological and societal. Education has the ability to impact upon environmental factors that lead todepression.

2.23 Teenage motherhood: An unturned chapter in the ruralareas

Education affects the timing of motherhood for women through two main points. First, education increases the opportunity cost of having children. Women with higher levels of education spend longer in schooling and delay marriage. Thus, child bearing process delays. High educational attainment could increase future earnings and subsequently increase the opportunity cost of having children. Secondly, education increases women's agency, ability or sense of power to take control of their lives, empowering them over the choice of fertility, partly through effects on self-esteem and aspirations, but also through changes in life possibilities. This may lead many women to delay child rearing into later adulthood.

Empirical studies show that women with low levels of educational qualifications tend to have children younger than their better educatedcounterparts.

The main difficulty in estimating the causal effect of education is the reverse causality of fertility on education. The presence of a child could prevent mothers attending school and, consequently, decrease the likelihood of high school completion.

Therefore fertility would cause low educational attainment. In order to deal with the problem of reverse causality, it has estimated the effect of early educational tests scores on the likelihood of becoming a teenage parent, using normalized tests of educational attainment at ages7,11and16addedtogetherintoasinglevariable.Forbothmalesandfemales ,theodds

of becoming a young parent – either a father before the age of 22 or a teenage mother – are more than three times higher for children attaining the lowest reading and maths test scores than children with the highest

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test scores. However, this is an effect of low cognitive attainment or ability not of educational participation.

The family background and childhood factors that are associated with teenage pregnancyusing two longitudinal datasets: the BCS70 and the BHPS. Mother‘s education, measured as an indicator variable for having any qualifications above O-Level – which is roughly equivalent to secondary education – have strong effects on the likelihood of becoming a teenage mother even after addressing reverse causality issues by controlling for a large range of child specific and family measures later inchildhood.

Not only qualifications, but school experience, positive or negative, can potentially impact upon sexual risk-taking behaviour and teenage pregnancy.

The relationship between dislike of school and sexual risk-taking behaviour and pregnancy using longitudinal data on girls between the ages of 13 and 16 in schools in central and southern England. As part of a cluster trial on sex education, baseline and two waves of follow-up data were collected from 27 mixed comprehensives randomly selected to either receive the sex education intervention or to serve as a control. Even after adjusting for measures of socioeconomic status, expectation of parenting, lack of expectation of education/training, and lack of knowledge or confidence about sexual health information, girls who disliked school were twice as likely to become pregnant in their teenage years. This research does not demonstrate a causal relationship, but rather highlights the strong relationship between attitude to school and risk of teenage pregnancy. This also happens in Indian villages.

The key issue here is that education has been found to have an effect on health via the adoption of health related practices, raising awareness of health information, and increasing personal resilience to effectively cope with difficulties or stress inducing circumstances. Certain aspects of education improve the ways in which individuals understand their health situation, express their symptoms, and communicate with the health

practitioner. More education can either increase or decrease the demand for treatments.

2.24 Work plan:

The World Plan of Action for the W o m e n ' s decade 1975-85 drew attention to the fact that "as long as w o m en remain illiterate and are subject to discrimination in educationand training, the motivation for change so badly needed to improve the quality of life will fail, for in most societies since it is the mother w h o is responsible for the training of her children during their formativeyears."

Rural women generally have little or no formal schooling. Hence, they are deprived of the usual channel for civic education which is an inherent part of formal schooling. Their need for civic education, however, has been more pronounced in recent years due to rapid changes in the compositions of regional societies. The male urban migration for paid employment, for example, has exacerbated the situation. A great number of rural households are now led by women (UNESCO 1985). These w o m e n are forced out of necessity to assume several roles and functions which were otherwise considered out of the realm of women's responsibilities, e.g., tax paying, reporting births, deaths, etc. They suddenly find themselves unequipped to cope with the various responsibilities thrust upon them. Lacking knowledge, experience, and worse, confidence, these women fare poorly in their new roles and end up with undue problems and/orexploitation.

There Is thus clearly an urgent need to provide civic education to this special group of women.

2.25 India's literacy atpresent:

The literacy rate in India as per 2011 census is 74.04-per cent. The growth of literacy among men is better in relation to that of women and by 2011, the rate of literacy among men is 82.14-per cent and among women it stands at 65.4 per cent at national level. Regional disparities, linguistic variations, social and economic aspects-all these are accounting for variations in the growth rate of literacy in our country. (Feinstein L. et al.)

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To improve this condition Government of India has taken a lot of initiative, as we have studied from the prior discussion that a proper education can uplift the illiterate section of nation because education is one of the life-saving medicines to cure a major part of illness.

And these initiatives are furnished below:

2.25.1 Farmers' Functional Literacy Programme

Farmers' Functional Literacy Programme (FFLP) was taken up in 1966-67 with the objective of extending education and training facilities to farmers with a view to raise agricultural production. It was felt that farmers training would become meaningful, if it is treated as an essential input of programmes (along with knowledge of fertilizers, pesticides,irrigation, high yielding varieties of seeds, multiple cropping, intensive cash crops and intensive cattle development programmes.

In order to make FFLP effective, the following strategy was formulated:

1. Farmers'education and training programmes should be co-ordinated so as to achieve quick production. All government and non-government agencies should organize their programmes according to production requirements andcropping.
2. The education and training should result in the acquisition of skills for the adoption of new practices and use of inputs. At some point, there should be connection between the supply of inputs and the imparting of training. Demonstration in the use of these skills should be an essential element oftraining.
3. There should be two-way communication between the participating farmers and experts. This means that farmers should be able to address their enquiries to experts of a level higher than the average level extension worker and get replies in writing. The radio programmes should be drawn according to the progress of the crop season and the education and training should be provided at the demonstration camps. Every aspect of the extension and education programmes should revolve around the agricultural productionprogrammes.

2.25.2 Adult Education forWomen

The Government of India has launched a number of adult literacy programmes, which also cater to literacy of adult women. However, a schemeof functional literacy for women (1975) has been brought about as a high priority programme of the Department of Social Welfare. The scheme is being implemented by the Integrated Child Development Services (ICDS) project. It focuses its attention on adult women in the age group of 15 to 45 years. It (a)helps women to acquire skills through functional literacy classes, (b) imparts information on modern methods of health and hygiene and the importance of nutritious food and balanced diet and (c) provides need-based training in home management and childcare.

2.25.3Rural Functional LiteracyProject

This was a major centrally sponsored scheme started in 1978 in rural areas as part of National Adult Education Programme. The erstwhile 144 farmer‘s functional literacy projects and 60 non-formal education projects were merged into it. Furthermore, new projects wereadded bringing the total number of projects throughout the country in 1987 to 513, each having up to a maximum number of 300 adult education centres and each centre having 25-30 learners.

2.25.4 Saakshar Bharat Programme

Literacy is central not only to all _Education for All goals, but also to the Government of India‘s overall philosophy of _inclusive growth and national aspiration for global leadership in the 21st century. All policy interventions, including poverty alleviation, gender parity, women empowerment, and higher GDP growth aimed at achieving these objectives, presuppose high levels of literacy, especially amongst women. There is a growing realization that leadership in the 21st century world, which is fast emerging as a conglomerate of knowledge based economies and informed societies, will vest with literate democratic societies.

_SaaksharBharat‘ will be a national response to the development of quality human resource to meet the demands of a fast changing _Bharat‘ as well as challenges of globalization. It will create a nationwide framework

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of life long learning that promotes a literate society through a comprehensive adult education programme by building environment that foster literacy amongst adults, particularly women, in the age group of 15 years and beyond. The Government will meet the entire cost of imparting literacy under this programme.

2.25.5 Functional LiteracyProgramme

- Instructional learning of about 300 hours that would enable the learner to acquire proficiency in Reading, Writing and Arithmetic (3 'R's) equivalent to Standard III in formal schooling system.
- Besides the 3 R's, the programme will focus on empowerment, transformation and application of literacy skills.
- Though a mass campaign approach will be the dominant strategy, given the diversified needs of different target groups, diverse strategies will be adopted, including resident camps, resident instructors and theme based literacy interventions.

So, these initiative can help the rural women, farming women or farming community as a whole in up gradation of their daily lives, from working condition, wage, payments to take care of their health. And the education will show the path.

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