REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

This chapter presents the literature relevant to the topic, which helps the investigator to give a clear and better picture of what has been done and what need to be done. Therefore it helps the investigator in bridging the research gap. In order to make the research topic more comprehensive, this chapter is divided into following sub headings.

2.1. Organic Farming

2.2 Participation of Women in Various Agriculture Activities

2.3 Anthropometric Data of Women Farmers

2.4 Workload Experienced by Women Farmers in terms of

2.4.1 Cardio vascular stress (Heart rate)

2.4.2 Energy expenditure

2.4.3 Muscular stress (Grip strength)

2.5 Body Discomfort/Occupational Health Hazards Experienced by Women Farmers

2.6 Work Rest Allowance Required in Various Activities

2.7 Miscellaneous studies

2.1 Organic Farming

Consciousness towards environmental issues is increasing all over the world. High dosage of fertilizers and liberal use of synthetic pesticides can pollute water, air and soil. Pests can develop resistance to pesticides and health of the soil is also adversely affected. Certain micro-nutrients such as zinc, copper and

iron become deficient in the soil over a period of time, as a result it becomes increasingly difficult for farmers to sustain high yields year after year.

How can we face this critical dilemma of consistently obtaining high crop yields without polluting soil, water air and without depleting the soil fertility ? The answer perhaps lies in organic farming. Organic farming is the system of farming that refrains from the use of synthetic fertilizers, pesticides and pharmaceutical at every stage of cultivation, harvesting and packaging.

In 1984, a study conducted by **FAO**, analysed as many as 1500 samples of cereals, pulses, milk, oil and meat from different parts of India. Almost all samples were contaminated with DDT and BHC. More worrying was in as many as 25 per cent of the samples, residue level had crossed the WHO safety limit.

Another study conducted by Global Environment Monitoring Programmes, sponsored by UN showed that even the breast milk, nature's best gift to new born is not free from DDT and BHC residues. Indian babies are taking three times more than the acceptable daily limits of these pesticides. (**Chengappa and Rajghatta, 1989**).

According to **Lampkin (1990)** organic farming is a production system which avoids or largely excludes the use of synthetic fertilizers, pesticides, growth regulators, livestock feed additives. Organic farming system rely on crop rotation, crop residues, animal manures, legumes, green manures, off farm organic wastes and aspects of biological pest control to maintain soil productivity, to supply plant nutrients, to control insects, weeds and other pests.

Henning et al (1990) reported that there is evidence that credit agencies are reluctant to finance organic farmers largely because of their small size vis-à-vis the size of credit agencies regular clients and because of the agencies poor understanding of how organic farming system work.

A technical report of **AICRP (1994)** on pesticides noted that about 52 per cent of samples of meat from different categories of animals contain DDT and HCH

residues, 74 per cent of fish sample from West Bengal found Endosulfan addition to BHC and DDT. It was found that 73 per cent of egg samples were contaminated with DDT and HCH.

According to **Chander (1996)** some of the hindrances to promotion of organic agriculture in developing countries are lack of documentation on organic farming packages of practices, poorly equipped extension personnel on sustainable organic agriculture practices, lack of governmental support, near absence of organic certification agencies within the countries, poor market infrastructure for organic products, poor producers-consumers awareness on organic agriculture and marketing practices, lack of education and training facilities on organic farming.

According to **IFOAM India (1996)** conventional farming is a system depend upon the inputs of artificial fertilizers or chemicals and pesticides or in other words it is not in conformity with basic standards of organic production.

According to WHO estimates there are about one million poisoning due to pesticides yearly with about 20,000 deaths and about 80 per cent of poisoning occur in developing countries though they account for less than 25 per cent of pesticides used (**Watts and Macfarlane, 1997**).

According to **Sharma (2001)** the high cost of certification is a problem of organic farmers of the developing countries. Few developing countries have certification agencies within their borders and even when sufficient resources are available to pay for certification, farmers often lack the information to find credible inspector.

Singh (2001) reported that the factors that have contributed to the lack of development of organic market in India include low awareness about the perils of chemically farmed products, high prices of organic products, lack of consumer confidence in organic food standards and erratic supply.

Pathak (2002) conducted a study on farmers practices in relation to organic animal standard in West Bengal. It was found that most of the animal

management practices of the farmers were organic except few like lack of record keeping, lack of fresh drinking water for animals, no farmer cultivated fodder crops and source of feed of animal was not organic in any case.

After reviewing the literature it was concluded that though organic farming is essential for healthy environment but people are not very much aware about it. Therefore there is need to conduct research on organic farming practices followed by people.

2.2 Participation of Women in Various Agriculture Activities

Women in rural India play a major role in shaping the country's economy through their active participation in agriculture. At present the women work force in agriculture and allied sectors is estimated about 61 million which accounts to about 30 per cent of the total rural workers in the country. The rural women are usually employed in arduous field operations like sowing behind the plough, transplanting, weeding, inter-culture, harvesting, threshing and winnowing. Most of the work related to management of cattle and other farm animals is done by women. They also carry the burden of household work and farm management. Studies have shown that the Indian women work for about 14 - 16 hours a day to carry out the most arduous activities on farm and at home. Though modernization of agriculture is taking place at a rapid pace, jobs attended by women more or less remained the same. The various studies were conducted on participation of women in agricultural activities.

Verma (1978) reported that women's main means of production is their own body, their hands for performing most of the agriculture operations like sowing, transplanting, weeding, harvesting, threshing and winnowing.

Srivastava (1985) conducted a study on drudgery faced by women farmers in various agriculture activities. Findings of the study showed that women in agriculture involved in repetitive and monotonous jobs. They performed transplanting and harvesting of paddy for long hours in a standing cum bending

posture. Tool used for harvesting was traditional sickle. Winnowing was another monotonous and time consuming operation which was performed by women farmers.

Sharma (1986) reported that in Haryana women participated in activities like transplanting, sowing, weeding, harvesting, winnowing and threshing. They also helped the men in preparing the field, hoeing and carrying load of fodder crops on their heads to the home.

Sen (1986) conducted a study with the objectives of studying the participation of women in agriculture in India. The findings showed that women farmers were mainly occupied in transplanting, weeding, harvesting and post harvest operations.

Another interesting study entitled "Women in agriculture" was conducted by **Gandhi (1986)**. The findings showed that activities such as transplanting of crops, and harvesting were women dominated activities.

Kaur (1988) in Haryana reported that women spent maximum time in harvesting in both the seasons (141.15 hours in *kharif* and 100.18 hours in *rabi* season) i.e. on weeding (109.07 hours), threshing (37.64 hours), post harvesting activities (36.22 hours), in *kharif* season and weeding (44.02 hours) threshing (54.61 hours) and post harvesting activities (38.17 hours) in *rabi* season.

An attempt was made by **Sinha and Verma (1988)** to identify the drudgery index of some major agriculture operations performed by women farmers Finding of the study revealed that pesticide dusting was considered to be highest drudgery prone activity followed by harvesting, carrying load on head, spade work in field, irrigation, seeding by *kurpi*, weeding by *kasola*, transplanting, sowing behind plough. It was also found that drudgery load of women was more than that of man in wheat and paddy crops because women spend more hours than men, and women oriented tasks were monotonous and repetitious.

Sikka and Swaroop (1990) studied the involvement of women in farm and non-farm activities. Females contributed 22.60 per cent time in cattle management, 45.00 per cent time to farm activities like weeding, hoeing and harvesting. The per day utilization in farm activities showed that on an average female spent 3 - 10 hours.

According to **Grover and Verma (1993)** in animal husbandry the maximum time spent by the women is in fodder collection, feed preparation, while in farm activities their maximum time was spent in harvesting, threshing and storage activities.

Sumal (1993) observed that women generally work more than fifteen hours a day attending to the agriculture systems like collection of fuel, fodder and water as well as weeding and animal husbandry.

These findings with slight variation have been supported by **Verma, (1984); Munjal et al (1985), Kaur (1988), Verma (1992), Ahuja et al (1993), Sharma (1993).** Women belonged to low socio-economic status spent maximum time in farm related activities **(Devi, 1987; Ahuja et al, 1993)**

From the above review of literature it may be concluded that the women farmers do all sorts of agriculture operations like collection of cow dung, transportation of manure to the field, harvesting, weeding, application of manure etc.

2.3 Anthropometric Data of Women Farmers

Anthropometric data includes data on various body dimensions of workers Seventy nine body dimensions have been identified. For finding out the workload of women farmers it is necessary to study their anthroprometric data.

Some anthropometric data on Indian female workers are given in **table 2.1**.

Table 2.1 : Anthropometric Data on Indian Female Workers

Body Dimensions	Nag & Chatterjee (1981)	Nag et al (1987)	Varghese (1993)	Oberoi et al (1996)	Vatsa (1996)
No of subjects	8 0	-	120 0	200 0	100 0
Weight (kg)	41 2	45 0	-	-	44 5
Stature	149 4	149 8	153 2	157 8	148 3
Chest circumference	-	72 9	-	-	-
Bideltoid breadth	-	35 8	-	-	-
Sitting height	-	78 1	78 1	83 1	78 9

Source Gite and Singh (1997) Ergonomics in agricultural and allied activities in India, CIAE, Bhopal

AICRP (2000) reported that when dibbling activity was performed average height of the farm women in two selected age groups viz 25-30 and 35-45 years ranged between 138 - 160 cm, average weight from 34-62 kg, Vo_2 (max) score ranged from 25.44 - 49.60.(ml/kg min.) All the younger women were in the good category of aerobic capacity, whereas older women were in average and low average category respectively It was observed that age was negatively correlated with Vo_2 (max) indicating that with the increase of age Vo_2 (max) tend to decrease. Beside this 47.00 per cent women were found in ectomorphic category indicating poorly developed body, 24 00 percent in mesomorphic (average) and 5.00 percent in endomorphic (good) Results showed that 47 50 per cent of farm women were having high average physical fitness index score, 26 00 per cent in below average and only 2 0 per cent had very good score on physical fitness index score

Study conducted by **AICRP (2001)** on ten women farmers involved in cutting and collecting fodder indicated that mean age of the women farmers was 30 90 ± 8 69 years, mean height was 156 60 ± 5 82 cm, weight was 44 60 ± 5 21 kgs and their aerobic capacity score was 31 34 ± 4 62 ml/kg min) Beside this 80 per cent of them were endomorphic and 20 per cent of them were mesomorphic When physical fitness of women farmers were studied, it was found that 60 percent

of them were having high average score, 30 per cent of them were having good score and 10 per cent had very good score on physical fitness index.

Gite and Singh (2001) reported that mean height and weight of Indian female agricultural workers are 148 cm and 45 kg respectively as against 163 cm and 50 kg for male workers.

Therefore, it can be seen that in many cases the equipment will have to be designed keeping in view the limiting dimensions of women workers in considerations. It will help to make the equipment women friendly and safe for operation.

2.4 Workload Experienced by Women Farmers

Ergonomics (human engineering) is the scientific study of relationship between man and his working environment. The term environment includes his tools and materials, methods of work, ambient conditions and physical environment of work and organization of the work. The scope of ergonomics application includes fitting the demands of work according to the efficiency of man in order to reduce stress, designing machine, equipment so that they can be operated with great efficiency, accuracy and safety.

Importance of ergonomics has been well established and recognized in industry and military applications. However ergonomics is equally important and relevant in agriculture. It helps in increasing the efficiency and thereby productivity of the worker without jeopardizing the health of them. (**Gite and Singh 1997**)

Work load experience by women farmers while performing various activities are expressed in terms of heart rate, energy expenditure, muscular stress etc For an eight hour work period for women workers, a workload requiring oxygen at a rate of 0.61liter/min is considered as the upper limit for acceptable workload. The heart rate for such a workload will be about 105 beats/min. Data on heart rate, energy expenditure and muscular stress of

women workers need to be collected for different operations. It will help in finding the workload experience by them. On the basis of that data we could suggest the new tools and technologies to them so that they may alleviate themselves from drudgery.

2.4.1 Cardio vascular stress (Heart rate)

During physical activity the heart rate and oxygen consumption rate may be increased, depending upon the workload and the maximum values which could be attained in normal healthy individuals are about 190 beats/minute for heart rate and 2.01 litre/min. (upto Vo_2 max) for oxygen consumption rate. However, at this extreme workload, a person can work only for few seconds. Generally, a workload which requires oxygen at a rate of about 35 per cent of Vo_2 max is considered as the acceptable workload for Indian workers (**Saha et al 1979**) and the values work out to be 0.70 litre/min. and 0.63 litre/min for male and female workers respectively (**Gite, 1993**). The corresponding heart rate values for this workload will be about 110 beats/min for men and 105 beats / min for women.

Table 2.2 : Heart Rate of Male Workers in Agricultural Operations

Agriculture Operations	Heart rate beats/min.	Source
Digging soil with pick axe	155.20	Kaur and Splinter (1964)
Digging soil with spade	134 90	Kaur and Splinter (1964)
	131 20	Nag et al (1980)
	172.00	Pradhan et al (1986)
Fertilizer application by broad casting	126.30	Nag et al (1980)
Seeding with manual seeder in wetland	154 00	Nag and Dutt (1980)
Transplanting of rice in bending posture	109.20	Nag et al (1980)
Weeding by uprooting the weeds in sitting posture	113 30	Nag and Dutt (1979)
Weeding with hand tools in sitting posture	98 00	Yadav and Gite (1987)
Harvesting with sickle	99.00	Nag et al (1980)
Rice threshing by beating	135 80	Nag and Dutt (1980)
Winnowing (standing)	124.30	Nag et al (1980)

Source Gite and Singh (1997) Ergonomics in agricultural and allied activities in India, CIAE., Bhopal

Broucha (1967) has examined recovery heart rate as an index of the cardio vascular strain and claimed that method to be more reliable than measurement of the total working pulse during exercise.

Dhesi (1970) found that various body positions accounted for variation in the heart rate significantly. Heart rate differed significantly at the ball making, rolling and puffing action position from the normal sitting position, the angle of ankle and knee bend were significantly affecting heart rate. She also found that a relative increase in the angle of the armpit and knee bend would decrease heart rate of workers.

Gamberala (1972) obtained a significant correlation between perceived exertion and O_2 consumption at the maximal levels and linear relationship between perceived exertion and heart rate while carrying load.

An interesting study was conducted by **Nag and Dutt (1980)** on cardio respiratory efficiency in some agricultural work i.e. germinating seedlings and threshing. It was observed that average heart rate of 5 male subjects during rest was 75.2 ± 5.5 beats/min and it was increased during pedal threshing i.e 140.8 ± 4.3 beats/min. Similarly when seedling operation was done the heart rate increased from 75.2 ± 5.5 (in rest) to 109.2 ± 3.0 beats/min.

Nag and Chatterjee (1981) conducted a study on physiological reactions of eight female workers in Indian agriculture works with a view to standardizing occupational work load of them. Maximum oxygen uptake (Vo_2 max) was 1.892 litre per minute. Their daily energy intake was 11.65 MJ of which 85 per cent was derived from carbohydrate. Average work pulse rate in many tasks was more than 130 beats/minute. Pounding alone or in pairs and digging of dry soil were the heaviest jobs, while harvesting, transplanting, uprooting and carrying load were moderately heavy. Whole day energy expenditure was 10.61 MJ

In a study on farm women found that energy expenditure for household activities ranged from 1.48 to 3.04 kcal/min and for farm activities from 1.93 to 2.88 kcal/min with heart rate of 93 to 135 beats/min. (**Rao, 1987**)

A study was carried out by **Rama (1990)** to study the relationship between the physiological cost and perceived exertion, the overall physiological cost of the selected activities along with their corresponding perceived exertion were scored. It was reported that among the selected farm activities, the cotton picking activity showed the least heart rate responses of 103 beats/min with the corresponding energy expenditure of 1.93 kcal/min/m^2.

According to **Bhattacharjee (1995)** a study with Assamese rural women examined the range of household activities they are involved in drudgery resulted from various factors like traditional posture while performing work, work environment, lack of facilities available, economic status as well as lack of information on modern technologies.

Murayana and Ohtsuka (1999) found that the change of body weight was modest but differed significantly ($P \leq 0.01$) between pre harvest and post harvest seasons i.e. 1.3 kg (2.3 per cent) for males, 2.5 kg (4.3 per cent) for females. Total energy expenditure (TEE) fluctuated markedly between the four seasons ($P \leq 0.01$) for males and females but total energy intake (TEI) fluctuated to lesser extents ($p \leq 0.05$) for female only. The change in body weight were significantly correlated with the change in TEE ($r = 0.60$, $p \leq 0.05$) for males, $r = 0.33$ $p \leq 0.01$ for females.

Kirk and Sullman (2001) examined the physical strain experienced by cable hauler choker setters, and applicability of heart rate indices for measuring physical strain in commercial forest harvesting operations in New Zealand The heart rate of four choker setter were recorded continuously throughout the working day and applied to heart rate indices. The specific task of line shift (120.3±4 8 beats/min) and uphills travel (126.1±12.9 beats/min) imposed the most severe workload on the choker. This research also demonstrated that

heart rate indices could be used as an effective means of determining the physiological strain of subjects working in commercial forest harvesting operations

2.4.2 Energy expenditure

Energy expenditure rate of a worker while performing a job can be calculated by using heart rate data Energy expenditure in some agricultural and allied activities are given below

Table 2.3 : Energy Expenditure of Workers in Different Agriculture Operations

Agriculture Operations	Energy expenditure KJ/min.	Source
Digging soil with spade	22 50	Nag et al (1980)
Fertilizer application by broadcasting	9 07	Nag et al (1980)
Seedling with manual seeder in wetland	33 40	Nag and Dutt (1980)
Transplanting rice in wetland	13 00	Nag et al (1980)
Weeding with wheel hoe	10 50	Gite et al (1993)
Harvesting with sickle	10 25	Nag et al (1980)
Rice threshing by beating winnowing (standing)	19 26	Nag et al (1980)

Source Gite and Singh (1997) Ergonomics in agricultural and allied activities in India, CIAE, Bhopal

Phillips (1954) estimated energy expenditure of six women with mean body weight of 55 kg during grass cutting and hoeing The mean energy expenditure was found to be 4 3 and 4.4 kcal / min respectively

Brown (1961) reported that body weight of the individual and his energy expenditure had a linear relationship In dynamic activity the weight of the body itself was considered to constitute the energy load

Park and Rodburd (1962) found that the excessive bending of leg and abdominal muscles increased the oxygen consumption resulting in increased energy expenditure.

Andrew (1963) studied the relationship between the energy expenditure rate and heart rate for the limbs involved and the kind of work i.e dynamic, static or a combination of dynamic and static. Significant relationship was not found between the heart rate and energy expenditure during the static and dynamic work

Banerjee and Saha (1970) observed that higher physiological cost with increase in body weight was expected due to the movement of heavy body concurrently involving greater muscular efforts and consequently higher energy demand.

Brun (1979) graded agricultural activities by men of 57 kg based on energy expenditure as moderate (4 4 to 6 5 kcal/min.) or heavy (6.6 - 8.7 kcal/min)

Nag and Dutta (1979) studied the physiological responses during weeding operation The energy required for weeding, while sitting with one or both legs flexed at the knee was 2 83 kcal/min while it was 2.90 kcal/min. during weeding by binding. After comparing the physiological demand work performance and preference of the workers, the wheel hoe type weeder was found to be the best for Indian women.

Joshi (1985) found out that the relationship between heart rate and energy expenditure of workers among various activities. Heart rate, perceived exertion, body surface area and energy expenditure of workers were positive and statistically significant at one per cent level of significance in all the home and farm activities. Thus with the increase in heart rate, energy expenditure and rate of perceived exertion also increased

Gite et al (1991) conducted a study on a lever operated knapsack sprayer. The study was conducted on ten subjects During the operation of this sprayer, the mean heart rate, oxygen uptake and energy expenditure of the subjects were found to be 94 6 beats/min, 0 454 l/min. and 9 48 kJ/min respectively

Tewari et al (1991) conducted a study on three manually operated weeding devices From the data relationship between energy expenditure rate and

oxygen consumption rate and heart rate were established Field test were carried out with the three weeders in a farm with *Arhar* crop (*Cajannus cajan*) during August - September when the average ambient temperature and relative humidity were 36 °c and 82 00 per cent respectively The three weeders used vary in design and their operations required different postures The average work pulse rate for all subjects varied from 104 8 ± 0.46 to 129 2 ± 7 8 beats / min It was observed that cardio - vascular demands of weeding by a '*khurpi*' were slightly lower than by a 3 - tine hoe and a spade. Similarly the oxygen uptake for weeding by a '*khurpi*' was observed to be minimum (13.8 ± 4 2 to 16 4 ± 3.1) followed by a 3 time hoe (18 37 ± 15.8 to 20 43 ± 6.8ml/kg min.) and a spade (20.89 ± 2 3 to 26.75 ± 5 1). The relative energy cost of weeding for each of the three weeding devices considered together varied between a minimum of 25 35 ± 18.7% to a maximum of 54.4 ± 9.4% of the maximum oxygen uptake (Vo_2 - max) it was concluded that weeding with these three weeders could be graded as 'moderately heavy' work However, the '*khurpi*' appears to involved less energy consumption The weeding efficiency with the '*khurpi*' was observed to be highest followed by the spade and 3 time hoe

In **AICRP report (1999)** it was found that women in different states of India are engaged in various jobs and have to carry the work load ranging from light to very heavy in weight on their head, shoulders, back, hands etc They found that in the age group of 21 - 30 years of age for fetching of water the heart rate increased upto 102 73 beats/min. For 31 - 40 years of aged women heart rate increased upto 107.38 beats/min. The energy expenditure was 7 32 kJ/min, 8 41 kJmin, 11.50 kJ/min, 12 03 kJ/min respectively. The total cardiac cost of work was 574 43 and 528 80 beats respectively for different age group.

From this review it was found that since energy expenditure is related with cardio-vascular stress therefore it also affects the work load experienced by women in various activities

2.4.3 Muscular stress (Grip strength)

Researches showed that absolute limit of grip strength after performing various repetitive task become reduced. It is because after performing any activity repetitiously muscles become tired resulted into lot of muscular stress.

Adams (1988) reported that hand grip strength is an important limiting factor in many occupational task. Grip strength is affected by many factors such as orientation to the work surface, place of rotation of hand, working position, resisting force dynamics, repetition of task, barriers to motion, grip diameter and surface area, use of gloves, gender etc.Beside this body dimensions, body weight hand length and other arm dimensions are significantly correlated with handgrip strength. On an average, female grip strength is about 50 – 60 per cent of male grip strength. It is because the size of female hand is smaller than males. However, experimental results have not been established this gender difference unequivocally, some results indicate that the female optimal is smaller but other indicates that both sexes have same optimal range. Gloves often increase hand grip forque strength provided there is sufficient clearance to accommodate the glove. Moreover, good surface friction with the grasped object should be provided when designing the tools for workers.

AICRP (2001) conducted a study on dibbling activity. Muscular stress (grip strength) of the respondents of two age groups i.e. 25-35 yrs and 36-45 yrs and were measured. Findings of the study indicated that average grip strength of the respondents during dibbling was highest amongst younger age group as compared to older age group. Percentage change in grip strength (muscular stress) of subjects during rest and after dibbling were higher among older women These changes were higher during the work performed by left hand than right hand of the older women.

Agarwal and Sharma (2003) conducted a study on work related muscular stress (handgrip) and time expenditure pattern of women workers involved in food processing industries. Findings of the study showed that mean muscular strength (hand grip) of right hand and left hand during rest was 17.17 ± 0 77 kg

and 17.47 ± 0.87 kg. respectively but as soon as women performed various activities like washing, peeling, cutting, cooking, packing etc the muscular strength of both the hands become decreased. Maximum decrease in muscular strength was found during cutting of fruits and vegetables i.e. 8.15 ± 0.58 kg for right hand and 9.92 ± 0.77 kg for left hand. It was concluded that due to poorly designed technologies these women were spending more time and experiencing lot of muscular stress (hand grip).

After reviewing the literature on muscular stress (grip strength) it was found that very little literature is available on muscular stress (grip strength) experience by women farmers. Since, grip strength information is important for designing hand tools and other work equipment and for designing and evaluation of work task therefore, there is a need to study this parameter in depth.

2.5 Body Discomfort/Occupational Health Hazards Experienced by Women Farmers

Discomfort is the body pain arising as a result of the working posture and / or the excessive stress on muscles due to the effort involved in the activity in many studies carried out in the country, this parameter has been used for comparison of drudgery involved in different activities / equipment and those include **Gite and Yadav (1990), De and Sen (1991), Ghugare et al (1991), Gite (1991), Gite et al (1993) and Gite (1996).**

Sakai et al (1993) reported that agricultural work has resulted in an increase in size of female labour forces making it more than 60 per cent of the population engaged in agriculture. There is still a considerable muscular work load in women's job and this causes various health problems of the women farmers. Results of the study also showed that backache was prevalent among most of these women.

Women in farming might experience increased risk of cancer as well as protective effect of post menopausal breast cancer. Statistically significant increased risk in association with farming were estimated for skin melanoma and bladder cancer. Lung cancer was also found to be increasing but not as a statistically significant level **(Settimi et al 1999).**

Sharma (1995) reported that negative correlation (r = -0.961 sig. at 0.01 level) was found between frequency of occurrence of occupational health problem and output of women workers.

Xiaing et al (1999) found that back pain is an occupational health problem among farmers on small operations or family farms. A total of 194 farmers (26.20 per cent) reported to have atleast one episode of back pain lasting for one week or more. Lower back pain was the predominantly effected part of the body in 45.40 per cent of males and 43.90 per cent of females. Back pain was brought on by repeated activities.

Batliwala (1988), Vanackore (1988), Asia and Pacific Development Centre (1989) and Vimal (1992) attempted to study occupational health hazards in agriculture. It was found that agricultural related health hazards were mainly toxic hazards and accidents. The consumption of agro-chemicals had increased tenfold over the last three decades. There were 52.00 per cent cases of pesticides poisoning and 89.00 per cent work accidents, 69.00 per cent work wounds. It was found that 40.00 per cent of all infant deaths occurred in the monsoon months (July to October) when the fields were being prepared for sowing operations and seedlings the figure worse to 61.00 per cent. Agriculture labourers were also prone to snake bites as well as bites of the insects.

Jearth (1970), Sudhir (1992), Vimal (1992) and Varghese et al (1994) reported the occupational diseases and musculoskeletal health problems of workers in agricultural work. It was found that agricultural workers faced toxic hazards while using fertilizers, insecticides and herbicides They were victims of byssinosis, bagossosis, pulmonary tuberculosis and occupational cancer Agricultural workers were in close contact with animals or their products due

to this they suffered from preumoconiosis and allergies. Women workers also involved standing in stagnant water during transplanting of rice etc. therefore they easily picked up parasitic infections. They also suffered from various musculoskeletal problems i.e. about 2/3rd of the subjects complained pain in upper arm.

A number of studies reported by **Bedale (1924), Busca and Granati (1945), Christian (1953), Keiser and Weaver (1962), Durwin (1967), Snook and Irvine (1969), Phllips et al (1971) Burn (1979), Singh (1989), Rama (1990), Sharma and Thakur (1998)** found significant relationship between the fatigue or rate of perceived exertion, pulse rate, respiration rate, heart rate, energy expenditure. Working in any unusual posture increased the loading on the heart rate therefore oxygen consumption rate simultaneously increased The consequences of poor working conditions are seen as musculo- skeletal disorders, illness and injuries sustained from the work.

Thus from the above review of literature it may be concluded that women farmers involved in farming activities have to face many health problems due to poor working posture, heavy workload, lack of knowledge of improved tools and technologies etc. Therefore, there is need to conduct research on them so that they can alleviate themselves from drudgery.

2.6 Work Rest Allowance Required in Various Activities

Spitzer (1952) has suggested a formula to calculate rest allowance for workers engaged in energetic heavy work. The formula is reproduced below.

$$\text{Rest allowance} = \left[\frac{\text{work, Kcal /min}}{4} - 1\right] \times 100$$

Muller (1953) has suggested two methods of approach to the problems of finding the duration and number of rest pause in heavy work. One method is to take 4 kcal /min as an overall limit of working capacity and to give enough

pauses to keep the average energy expenditure of the whole shift at this level. The other method is take the pulse rate as an index. This method ends at keeping the average pulse rate during the shift at constant level and to prevent any kind of pulse debt which leads to increase number of pauses during recovery after the end of work. The second method has proved useful in arranging pauses so as to allow a man to work with his endurance limit.

Broucha (1967) advocated the use of pulse rate technique in determining the physiological strain. According to him the acceptable heart rate which could be sustained for continuous shift work would be 110 beats/min. Activity demanding beyond this limit is likely to develop fatigue, and as such require rest pauses in between work cycle.

Saha et al (1973) suggests two types of rest pauses one for light work and the other for heavy work viz. 10 minutes of rest followed by 30 minutes of light work and 30 minutes of rest followed by 10 minutes of heavy work. It was shown by mathematical computation that such arrangements of work and rest periods would not only keep the level of physiological strain at an acceptable limit but also high production with less physiological cost.

Kamon (1982) has further suggested that if a period of one third of the time to exhaustion is used for any given work intensity between 0.5 Vo_2 max., a reasonable formula to determine the safe and acceptable working time to prevent fatigue could be as follows:

$$TW = \frac{40}{fVo_2\ max} - 39$$

Where TW = Working time in minutes

fVo_2 max = Fraction of Vo_2 max.

It was clear from the available literature that very little researches have been done on rest pause required in various activities. Since, it is important for increasing the efficiency of workers and for avoiding fatigue, therefore it is

essential to measure the rest pause required for women farmers while performing various activities.

2.7 Miscellaneous Studies

Cayle and Wardle (1977) conducted a study on women and strenuous work. The subjects consisted of eight paid volunteer female college students between 18 to 23 years of age. These subjects were all medically screened prior to participate. Those subjects were asked to work on the treadmill for eight different periods consisting of 45 minutes each at two speeds and carrying the load. The subject would have to work as light and two periods of moderate work. The subject would have their heart rate recorded the last 5 seconds of each third minute. The subject was instructed to work for the 45 minutes. The subject would have a rest period for 15 minutes. The findings showed that the heart rate was 119.8 beats/min for light work, 130.0 beats/min for moderate work and 139.80 beats/min for heavy work and 158.80 beat/min for very heavy work. Significant correlation was found between heart rate and energy expenditure. It was concluded that women of average stature and weight can perform many jobs requiring hard physical work.

Nag and Dutt (1980) conducted a study on circulo-respiratory performance of five subjects in relation to two types of agricultural activities i.e. on germinating seedlings and threshing. Manual operation were compare with some simple implements. When transplanting of seedling was done with IRRI seeder and CRRI seeders pulmonary ventilation and oxygen uptake were 41.9 liters/minute and 39.6 liters per minute respectively. Pulse rate was 163 and 164 beats/minute respectively. Further manual threshing with beating demanded 28.1 liter/minute pulmonary ventilation and 135.8 beats/minute heart rate. The corresponding values in case of pedal threshing were 41.2 liter/minute pulmonary ventilation and 140.8 beats/minute heart rate. It was concluded that IRRI seeder required 4-men hours per acre of land compared with 2-men hours for CRRI seeder. Moreover pedal thresher is about 50 per cent more efficient

perceive exertion than the same task perform with less frequency. Combination task usually resulted in greater discomfort, rate of perceive exertion and heart rate than single task. Further heart rate tended to be higher for task requiring crouching or stooping and for higher frequency task.

Hongwel et al (2002) conducted a study on anthropometric differences among various occupational groups. The results of the study showed that the body size or body segment measurements of some occupational groups differ significantly. Agricultural workers were shorter by an average of 2.5 cms in height and had wider wrist breadths than other workers i.e. construction labours, textiles labourers etc. Female agricultural and manufacturing workers had larger waist circumferences than those in the other occupations.

Agarwal and Sharma (2003) conducted a study on postural stress among Asian women workers involved in food processing industries. Findings of the study revealed that angle of spinal cord (postural stress) both for upper back and lower back during rest was 219.72 ± 3.40 degree and 211.37 ± 3.54 degree respectively. But as soon as women performed various activities like washing, peeling, cutting, cooking, packing etc. angle of spinal cord become increased. It was found that angle of spinal cord (postural stress) for upper back was highest (262.70 ± 4.32°) during cutting of fruits and vegetables and for lower back it was highest (239.72 ± 4.51°) during cooking of jam, jellies etc. Moreover, place of work used by these women workers were not ergonomically designed. Most of the activities were carried out on floor. There was lack of functional centres for performing various activities. It was also concluded that during cutting and cooking of fruits and vegetables women workers were remain in static posture for long hours and bending more which might impaired their blood supply causes lot of postural stress during these activities.

Singh and Sharma (2003) conducted a study on modes of lifting and transporting loads in rural hill areas of Kumaon, Nainital. Findings of the study reveled that women carry about 15-35 kg or more weight on head, shoulders, back or in hands either in erect standing, standing cum bending or bending

posture. They have to travel about 8-10 km, spending 6-8 hours daily and much more during the period of peak loads.

An interesting study was conducted by **Singh and Sharma (2003)** on modes of lifting and transporting loads in rural hill area indicated that women farmers suffered from various ailments while performing day to day, seasonal (storing grains, transporting cop residues, and threshing) and occasional activities i.e transportation for milking, fetching fuel, transporting manure and delivering vegetables etc. It was found that women farmers were suffering from backache (53.33 per cent), limb pain (69.79 per cent), chest pain (39.03 per cent), palm pain (54.86 per cent) and forearm pain (64.33 per cent). Besides these ailments lifting heavy weight and carrying heavy loads on head by women leads to various gynecological consequences such as menstrual cycle disorders uterine prolapsed miscarriage causing serious long term repercussions.

Conclusion :

After reviewing the extensive literature it was found that although many researches has been done on participation and time expenditure of women in agricultural activities but there is dearth of information on workload experienced by women farmers in terms of cardiovascular stress, energy expenditure, muscular stress, hearth hazards experienced by them and how much rest pause women farmer should take for avoiding fatigue and for enhancing the efficiency. Moreover, how to protect our environment from indiscriminate use of chemicals, synthetic fertilizers, therefore a need was felt to conduct this study.