

***ASSESSMENT OF PHYSIOLOGICAL  
WORKLOAD OF FARM WOMEN IN  
RELATION TO THEIR NUTRITIONAL  
PROFILE***

**SUSHMA SINWAL**

**Thesis**

***Doctor of Philosophy in Home Science***  
**(Family Resource Management)**



**2008**

**DEPARTMENT OF FAMILY RESOURCE MANAGMENT**  
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This is to certify that the thesis entitled “**Assessment of Physiological Workload of Farm Women in relation to their Nutritional Profile**” submitted for the degree of Doctor of Philosophy in the subject of **Family Resource Management** embodies bonafide research work carried out by **Ms. Sushma Sinwal** under my guidance and supervision and that no part of this thesis has been submitted for any other degree. The assistant and help received during the course of investigation have been fully acknowledged. The draft of the thesis was also approved by the advisory committee in the pre-thesis submission seminar held on 11 January 2008.

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This is to certify that **Ms. Sushma Sinwal** student **Department of Family Resource Management**, College of Home Science has made all corrections/modifications in the thesis entitled **“Assessment of Physiological Workload of Farm Women in relation to their Nutritional Profile”** which were suggested by the external examiner and the advisory committee in the oral examination held on \_\_\_\_\_. The final copies of the thesis duly bound and corrected were submitted on \_\_\_\_\_ are enclosed herewith for approval.

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Ph.D. Thesis - 2008

Title : Assessment of Physiological Workload of Farm Women in Relation to their Nutritional Profile

#### ABSTRACT

In India, the farm women are not only involved in household activities but also contribute in various farm operations, animal husbandry, and agro-based, still a major portion of food is served first to adult males whether earning or not. The objective of the study was to assess nutritional profile of the farmwomen and occupational health problems faced by them, to compare the physiological workload in lean and peak seasons and to find out relationship between physiological workload and nutritional intake.

The present study was conducted in Girwa Panchayat Samiti of Udaipur district on a sample of 90 non-pregnant non-lactating farmwomen not suffering from any chronic disease and working in agriculture for not less than 10 years. Background information was gathered using an interview schedule, activity schedule in both lean and peak agriculture season was gathered using observation cum recall method, An Interview schedule was used to procure data on type of hazards in farm activities; hazard proneness was assessed using SAOHH (Singh and Sinwal, 2005). BMI was calculated using weight and height  $BMI (kg/m^2) = \text{Weight (kg)} / \text{Height}^2 (m)$ . On the basis of BMI a sub sample of 18 subjects was selected i.e. six from each landholding category representing the different grades of BMI i.e. obese, normal and CED.

Dietary survey by 24 hour recall method was conducted using the standardized cup set. Haemoglobin was estimated with the help of expert. The adequacy of diet was assessed in terms of type of food consumed and the intake of nutrient. Energy Intake was calculated using physiological fuel values of carbohydrate, fat and protein. Energy Expenditure Rate (EER) was calculated using formula given by Varghese et al. (1995):  $EER (kJ/min) = HR \text{ bpm} \times 0.159 - 8.72$ . Heart rate values were recorded using POLAR heart rate monitor. Total Energy Expenditure (TEE) on each activity was calculated using Formula:  $TEE (kJ) = \text{Energy expenditure rate (kJ/min)} \times \text{Time spent (min)}$ . Total Daily Energy Expenditure (TDEE) was calculated using formula:  $TDEE = \text{TEE of each activity throughout the day} + \text{BMR}$ . Energy Balance was calculated as:  $\text{Energy Balance} = \text{Energy Intake} - \text{Energy Expenditure}$ . To assess the physiological workload of the respondents an experiment on treadmill was designed using sub-maximal workload technique. The results revealed that all the respondents of all the categories were, more or less, performing all the agriculture, allied and household activities. In all the agriculture activities physiological hazards such as body pain and fatigue were dominant. Entire respondents were more or less facing occupational health hazards. Mechanical hazards like injury universally occurred due to farm tools and machinery. Chemical hazards like skin and respiratory problems were faced and environmental hazards like poisonous insects bites, effect of extreme temperature were other hazards confronted by the respondents. As hazard proneness increased as their BMI decreased. Dietary, nutritional and energy intake was lower than suggested by NIN (1998) for heavy workers, in all the respondents from all landholding and BMI categories. Their diet was cereal based.

Among agriculture activities Energy expenditure was highest in land preparation and lowest was in sowing. And in all agriculture activities EE was highest for LAL as they were paid labourers. In allied (dairy) activities highest energy expenditure was in cutting and collecting fodder, followed by cleaning animal and lowest was in making dung cake. Among household activities EE was highest in fetching water followed by washing cloths and lowest was in personal and child care. EE was highest for obese category of BMI. TDEE was highest during Land preparation, and lowest during sowing. HR and OCR was in linear relationship in all categories of BMI. Physical work capacity increases with

good nutritional status and decreases with age. CED and Obese has low MHR and  $VO_2$  max than normal. Regression equations were suggested for calculating oxygen consumption (y) at their known heart rate (x) during various agriculture operations :  $y = 0.007x - 0.301$ (CED),  $y = 0.0081x - 0.271$ (Normal),  $y = 0.0069x - 0.251$ (Obese) and  $y = 0.0086x - 0.469$  (General). There was non-significant difference in estimated and calculated values of oxygen consumption from regression equation at increasing heart rate (110-180 beats/min).

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## ***REVIEW OF LITERATURE***

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A comprehensive review of literature is a must in any research endeavor. The most important task for a researcher is to review the previous work done in the related field of study. It not only helps the investigator to define the frontiers of the field but also helps in avoiding unintentional replication of the previous work done.

In this chapter, relevant literature having direct or indirect bearing on the present experimental research has been reviewed and organized under the following categories:

### 2.1. Home, Agriculture and Allied Field activities

#### 2.1.1. Women's Participation

#### 2.1.2. Physiological workload

### 2.2. Occupational health hazards

#### 2.2.1. Agriculture work: A Hazardous occupation

#### 2.2.2. Effects of occupational hazards on health of the farm worker

### 2.3. Dietary Intake and Nutritional Status

### 2.4. Effect of Anemia and Hemoglobin level on Work Output

### 2.5. Energy Balance and Seasonal Variation

### 2.6. Relationship between HR and OCR

## **2.1. Home, Agriculture and Allied Field activities**

### **2.1.1. Women's Participation**

*"Women O' women on agriculture farm, wake up at dawn to clear the barn; to feed the ox and milk the cows, to cook the lunch to clean the house; you feed the children and send them to play, women o' women that begins your day; you hurry down the lane, to help at the farm, you work in the sun cool and calm; you store the grain to use all the year round. You do this without technical know how; from home to farm and back home , you think not of self-welfare, interest or gain; selflessly you*

A study conducted by MANAGE (1996) on "Women in Agriculture" in tribal districts of Himachal Pradesh indicated that women contribute 50.0 per cent of labour to all agricultural activities.

Sirohi (1996) reported that in land preparation activities like cleaning, leveling and manuring are predominantly performed by women and in fertilizer application also their participation was more. In inter cultural operations; women's participation was upto the extent of 82.89 per cent. Harvesting was mainly performed by women.

All India Coordinated Research Project in Home Science, FRM, 1998 revealed that the average time spent by women in farm activities varied from 30-240 min/day depending on the farming operation being performed.

Borah (1998) reported that women spent considerable amount of time in performance of agricultural tasks in peak season and allied tasks in Assam.

According to Eswaran *et al.* (2000) women in agriculture make up a substantial portion of the rural population. Like men, they undertake various types of agricultural operations. Their involvement was found in seed treatment, sowing, manuring, interculture, harvest and post harvest operations. Apart from participation in actual cultivation, women also participated in actual cultivation; processing and marketing of various agricultural produce.

A study was undertaken by Bimla *et al.* (2003) women's participation in agricultural activities in Kaithal district of Haryana. It was observed that the investment of rural women in agricultural activities was to the extent of 73.0 per cent. A woman spends 74.0 minutes to 413 minutes per day in doing her agricultural activities. It was observed that the transplanting was the most drudgery prone activity (62.2 per cent) among all the agricultural tasks, crushing and interculture ranked in second and third position.

Nagarjuna and Singh (2004) using paired comparison technique, calculated the perceived drudgery of women in agriculture and animal husbandry.

### **Perceived Drudgery of Women in Agriculture**

<b>S. No</b>	<b>Activity</b>	<b>Scale Value</b>	<b>Rank</b>
1	Carrying of load on head	1.6475	1

2	Harvesting-cutting	1.4855	2
3	Weeding	1.1845	3
4	Transplanting	1.1805	4
5	Picking	0.506	5
6	Bund formation	0.418	6
7	Manure application	0.217	7
8	Cleaning	0.177	8
9	Winnowing	0*	9

### Perceived Drudgery of Women in Animal Husbandry

S.No	Activities	Value scale	Rank
1	Procurement of fodder	2.217	1
2	Milking	1.257	2
3	Preparation of cowdung cake	1.002	3
4	Cleaning of cattle	0.892	4
5	Cleaning of cattle shed	0.869	5
6	Chaffing the fodder	0.830	6
7	Churning of milk	0.326	7
8	Feeding of animal	0*	8

\* The results are based on paired comparison scores represent the comparative drudgery level from our assumed 0 level which was assigned to the least drudgerous task.

According to Annual Report, CTRI (2003) cultivation of tobacco consists of three major operations. They are nursery management, field operation, and post-harvest processing. Nursery management and post-harvest processing provide good employment opportunities to women. In plant protection operations, harvesting and stringing the ratio of women and men is 2:1. The entire grading work of tobacco is carried out by women only. Raising nursery involves around 2860 women days per hectare, for a period of 90-100 days. The major contribution of women workers on tobacco nurseries is in weeding (46.6 per cent), closely followed by watering (21.2 per cent).

According to NCW Chairperson Advani (2005), whether it is a pre or post harvest technology, animal husbandry, poultry farming or fisheries not enough efforts have been made to reduce the drudgery of the women engaged in various farm operations. A profile of women work force indicates that more than 80.0 per cent of women workers are engaged in the agriculture sector in rural India. Some figures indicate that 75 million women are involved in agricultural activities as compared to only one million men. However their contribution is largely unrecognized and mostly under valued. Hardly any strategies have been planned to either improve their health or economic status (The Tribune, 2005).

### **2.1.2. Physiological Workload**

Solakhe and Mamansari (1995) worked out physical workload on agricultural workers during selected farm operations in paddy fields in Thailand. Four male and four female agricultural workers were randomly selected. Four common farm operations i.e. ploughing, planting, weeding, and harvesting were selected. During different farm operations heart rate, oxygen consumption and pulmonary ventilation were determined as a function of physical work capacity on a laboratory bicycle ergometer. Energy expenditure,

oxygen, pulse, and relative cost were also estimated. It was observed that the physical workload for ploughing, planting, weeding, and harvesting operations, expressed in percentage of physical work capacity was 44.0, 41.0, 33.0 and 44.0 per cent, respectively.

Sujata *et al.* 2000, attempted to measure the energy cost of activities of women from the poor socio-economic group in India. Women in the age group of 18–40 years (n=98) either working for incomes or classified as homemakers were randomly selected. Time disposition studies were conducted by a 24 hours observation of their activities on a typical day. Predominant activities were identified from the activity profiles and standardized for posture and duration. The BMR (Douglas bag method) and energy cost of the activities (Kofranyi–Michaelis meter) were measured by indirect calorimetry. The energy consumption during these activities ranged from 2.94–12.51 kJ/min. The tasks were divided into standard, household, childcare, occupational and other activities. Using the criteria, attempts were made to categorize the activities into light, moderate, and heavy. It was significant that except for walking, the standard activities and occupational work could be classified into the light category (< 2.2 BMR). Most of the household and childcare activities except cooking were classified into the moderate to heavy (2.2–> 2.8 BMR). The energy expenditure of activities did not differ significantly between women with different occupations.

A study was undertaken by Bimla *et al.* (2001) to determine the physical fitness, time and activity profile, physiological and biomechanical stress of women picking cotton. The field experiment on 60 women respondents in the age group of 25–45 years of age selected from rural areas of Haryana State was conducted. Body mass index was calculated 21.0 kg/m<sup>2</sup>. Aerobic capacity was found to be 1.76 l/min. rural women collected 20.24 kg of cotton per day during cotton picking and traveled a distance of 5.7 km. in five hours of activity. Average heart rate of women was measured 87.1 b<sup>-min</sup>, which increased upto 102.1 b<sup>-min</sup> during the activity. TCCW was calculated upto 5783 beats for the complete cycle of activity. Physiological workload of the women was graded as very heavy to moderately heavy during cotton-picking and backward journey. PCW was found maximum for cotton-picking activity. Woman perceived heavy to moderately heavy exertion after the activity.

An attempt was made by Borah *et al.* (2001) to assess the body composition, body type, physiological workload and physiological cost of sun drying of grains on the basis of Heart rate and Energy Expenditure of the respondents. Selected respondents for the field experiment were in the age groups of 21-30 years and 31 to 40 years having normal body temperature, blood pressure, and heart rate. The experiment was carried out both in winter and in summer seasons. Heart rate monitor was used to monitor the heart rate during the activity. Average age of the subjects was 31.82 years. Mean height and weight was 150.07 cm and 45.21 kg respectively. Mean Lean Body Mass (LBM) was found to be 30.47 kg., while Body Mass Index (BMI) was 19.8 and the  $VO_2$  max of the subjects was 1.62 L/min. Analysis of the body type of the selected respondents showed that 52.5 per cent had Ectomorph followed by 45.0 per cent having Mesomorph body type. On the basis of peak heart rate ( $b^{\text{min}}$ ) and peak energy expenditure (kJ/min), Sun drying of grains was categorized as a 'Heavy' activity. Physiological cost of work was found to be 33.1 beats/min. Average RPE (rating perceived exertion) was also highest i.e. '4' in 5 point RPE scale. Positive significant correlation was found between heart rate and RPE and energy expenditure and RPE.

Household activities performed by the rural homemakers are numerous but the maximum time is spent on cooking. Therefore, a study was undertaken by Jindal *et al* (2001) to study the physiological costs of cooking activity in rural households of Punjab state. The study was conducted in Moga district of Punjab state. One block was selected randomly from Moga district and from the selected block one village was selected randomly. A total of 15 families i.e. 5 each from three different farm size categories (small, medium and large) were selected randomly to study the physiological costs of cooking activity. The observations in triplicates were recorded starting from morning till night fall with respect to physiological parameters namely: energy expenditure (Calories), heart rate (beats/min), blood pressure (mm Hg), grip strength (kg) and distance traveled (meters) by the homemakers while performing the cooking activity. Energy expenditure for cooking was found to be more in medium (427.98 Calories/day) as compared to small (346.60 Calories/day) and large farm size category (364.67 Calories/day). Energy expenditure for cooking ranged from 1.31 Calories/minute to 1.54 Calories/minute and heart rate from 101.80-120.20 beats/minute as compared to 81.60-86.60 beats/minute at rest.

The research design comprised of a field study conducted on farmwomen by Mrunalini (2001). The results indicated that the activities caused an additional stress of 30.0 per cent on circulatory system over rest.

The ergonomic evaluation of the fetching water was done by Singh *et al* (2001). The average weight carried was 14.15 kg, the distance travelled was 0.056 km and total average time spend on the activity was 13.15 minutes per trip and 8-10 trips/day were made. The classification of workload showed that the task was 'moderately heavy' for the women of younger age group and 'high' to 'moderately heavy' for the women of

older age group. The physiological cost of work was 'heavy' in the morning and 'moderately heavy' in the evening for the younger group. The heart rate ranged from 106-116 b<sup>min</sup> and energy expenditure was 8-10 kJ/min, whereas the physiological cost of work was 'moderately heavy' in the morning and evening for the women of older age group, the heart rate being 106-111 b<sup>min</sup> with energy expenditure of 8-9 kJ/min.

A study was conducted by Sharma *et al.* (2001) in Tarai region Uttaranchal to find out the drudgery involved in milking activity performed by farm women as dairy was found one of the main occupation in which women of this region were engaged. The complete analysis of milking activity was performed, it was found that the average heart rate of respondents was higher during milking and backward journey i.e. 106.79 beats/min and 106.91 beats/min respectively which makes the activity moderately heavy (106 to 120 beats/min). As the heart rate increase the energy expenditure also increases to 8.25 kJ/min during milking. Where as in backward journey it reached upto 8.45 kJ/min, which made the complete activity moderately heavy (Shah and Varghese). The total cardiac cost of work (TCCW) was found 168.58 during milking and 523.24 when the activity was performed in complete cycle.

Ergonomic research by Susheela et al (2001) for evaluation of physiological, psycho-physiological occupational workload and physical fitness of the female agricultural labourers in performance of the selected agricultural activities was under taken by the Heart Rate Method, Rating of perceived Exertion, Step-Test and also by Aerobic capacity (VO<sub>2</sub> Max). Six villages around Dharwad in Karnataka and a sample of 140 female agricultural labourers working with large farmers were selected randomly from 20 clusters. Based on the classification of physiological workload of Varghese et.al, 1996, by the mean heart rate of the female labourers, the agricultural activities were classified from 'light' to 'heavy' category, whereas based on the peak heart rate responses the same activities were that of 'heavy' and 'very heavy' nature. The Female labourers perceived Rating of the perceived Exertion (RPE) the agricultural activities as 'heavy' and 'very heavy' nature. Further, as per the mean and peak heart rate responses, it was evident that 39.5 and 54.3 per cent of the female workers were working above the acceptable limits of workload. 'Peak loads' of work seems to have an impact on the overall physiological stress. Hence, a need for assessment of job-demand-fitness-compatibility emerged from the results of the study.

## **2.2. Occupational health hazard**

### **2.2.1. Agriculture work: A Hazardous occupation**

George and Ingle (1995) conducted study on involvement of women in rubber plantation in Kerala. The drudgery by women labour was assessed and it was concluded that:

- Head load transportation of mulch from distant places caused body pain.
- Transportation of latex to coagulation shed caused physical strain.
- Head load transportation of coagula to sheeting sheet was strenuous.
- Hand operation of rollers caused physical strains.
- Unhealthy conditions due to wet and acidic surrounding.
- Feeding scrap rubber to the crepe battery caused backache.

Regarding the health hazards of cotton workers Goeizer (1998) found that large number of cotton workers suffered from Byssinosis, an obstructive lung disease, due to the exposure to vegetable dust.

According to Ray (1998) even today Indian agriculture depends to a very large extent on manual labour. There is a high degree of back bending throughout the day during making of paddy bundles. Nowadays, manually or electrically operated threshing machines are available throughout the country. Though this has improved productivity, they have also caused an enormous increase in the rate of accidents, hand injuries because of their poor unsafe design.

Ogilvic (1999) studied farm injuries in Saskatchewan and found that with increased mechanization of the farm, accident involving farm equipments were common, as were injuries that occurred later in the day when workers were tired or late in the farming season when there was added pressure to get the work done. The most injured body parts were the extremities

such as fingers and limbs. The participants reported that after they are interviewed about accidents on their farm they were more careful when working and more attentive to safety concerns. This resulted in an immediate drop in the number of accidents on the farms.

Webster (1999) concludes that the most prevalent nature or principle physical characteristics identifying most fatal occupational injuries and illness involving clays away from work in the United States were sprains, strains, and tears. The part of the body most affected was the back, shoulders, and knees were the second most often sprained, strained and torn apart.

According to Meeker, Carruth and Holland (2002) women play an important role in farm management by marketing farm products, purchasing materials, and financial planning. Because of this involvement, women can be exposed to potential health hazards that can result in chronic illness, debilitation, or death. Their study explored and described health hazards affecting farm women, preventive measures used by farm women, and their consistency in using protective equipment during farm operations. Results showed that women working 1 to 20 hours per week were less likely to wear personal protective equipment (PPE) than women working more than 20 hours per week. This included wearing seat belts on tractors; using hearing, eye, or breathing protection; and wearing gloves or boots. No differences were found between groups for use of skin protection, hair holders, or helmets on all terrain vehicles. The researchers concluded that if interventions such as teaching and counseling related to

prevention methods could be provided, the incidence of acute and chronic illnesses and traumatic injury would decline.

Perry (2003) estimated that 2 million youth under the age of 20 live or work on farms. Approximately 103 farm fatalities occur in this age group each year. Children working in United States agriculture make up only 8.0 per cent of the population of working minors, yet they account for 40.0 per cent of work-related fatalities among minors. Farm children and youth are also exposed to potentially harmful chemicals, such as pesticides and solvents, and many of these exposures go undetected. The long-term health effects of exposure to pesticides or solvents are not known, but the developmental vulnerabilities of children and youth are of particular concern.

Little information currently exists regarding the risk of low-back disorders among youth performing physically demanding farm activities. A field study conducted by Allread et al (2004) on children and adolescents engaged in farm work showed that the magnitude of several work-related factors, such as weight and horizontal movement of arm, and trunk motions for many farm activities were equal to or greater than those associated with high injury risk jobs previously assessed in industrial workplaces. In this study, they quantified the physical demands of tasks performed by children and adolescents on farms and found that farm chores more likely to load the spines of youth contribute to musculoskeletal injuries.

Earle-Richardson et.al. (2004) adapted Posture-Activities-Tools-Handling (PATH) to quantify hazardous activities, loads and postures. They found that back, neck, and shoulder

strains were common among orchard workers. Little data currently exist regarding the ergonomic factors contributing to this problem. Mean coefficients of variation ranged from a low of 0.212 (standing leg neutral) to a high of 0.603 (trunk moderate flexion). Most frequently observed activities were picking (62.9 per cent), placing and moving apples in the bag (8.7 per cent) and walking (8.1 per cent). Weight bearing was observed 78.5 per cent of the time throughout a range of activities.

Miller, Webster and Mariger (2004) studied the nonfatal injury rates of agricultural producers. The purpose of this study was to identify the source and frequency of agricultural injuries and determine an injury rate for common agricultural activities.. The rate of injuries requiring medical treatment observed in this study was 19.9 per cent. Nearly half (48.7 per cent) of the injuries reported were treated at home or by a family member.

Mason and Richardson (2005) recorded and analyzed injuries to children on farms during a six-year reporting period (1992-1998). Of 164-recorded injuries to persons aged upto 18 years, 29 were fatalities, 18 were disabling, and 55 per cent occurred while working. Leading injury types were tractor run-over and overturns. Of those injured while working, 34 per cent were under the "job appropriate age limits". Tasks of loading hay (square bales), fieldwork with trailed implements and feeding calves most frequently involved very young victims. Grouped by injury source, injuries involving non-powered wagons had the highest frequency of under-age victims.

Depczynski et al (2005) gathered information on farm noise levels. Noise levels were recorded at the ear of the operators and any others in close proximity to noisy activities on farm. Common noise hazards identified through this study, which produce excessive noise included firearms, uncabined tractors, workshop tools, small motors (e.g. chainsaws, augers, pumps), heavy machinery – particularly older field machinery used for long hours such as cabined tractors, harvesters (grain, cotton, and sugar cane), bulldozers and cotton module presses. It was considered that the most extreme noise hazards on the farm (if unprotected) were firearms and uncabined tractors. He suggested that a greater awareness of these factors through dissemination of information would aim at preventing noise injury amongst farm workers and their families.

### **2.2.2. Effects of occupational hazards on health of the farm worker**

Linaker and Smedley (2002) found that respiratory diseases have long been recognized in association with work in farming. Farmers are known to have high morbidity and mortality from certain respiratory diseases. The most important diseases are rhinitis and asthma that are not usually fatal. Some non-allergic conditions, e.g. asthma-like syndrome and organic toxic dust syndrome appear to be common among farm workers. The most serious respiratory diseases are hypersensitivity pneumonitis and respiratory infections are rare. They suggest that respiratory diseases are preventable by controlling harmful exposures to organic dust, toxic gases and chemicals on farms through improvements in animal rearing techniques, ventilation of animal accommodation, careful drying and

storage of animal feed-stuffs, crops and other products, and use of personal protective equipment.

Solecki (2002) conducted a study on hearing loss among farmers aged 28– 65 who had a period of occupational activity of 11– 40 years. Statistically significant differences in mean hearing loss were observed between the 2 groups i.e. the farmers v/s control group. In the control group, abnormal hearing loss was noted in 17 per cent of people only for mean high frequency value. In the group of farmers a significant correlation was noted between hearing loss and age, as well as period of occupational activity. It was statistically confirmed that the most significant decrease in hearing occurred during the age interval up to the age of 50 and during the period of occupational activity of up to 30 years.

Mpofu *et al* (2002) found that occupational exposures to organic dusts, gases, welding fumes and agricultural chemicals result in farmers increased risk of respiratory health problems. They summarized their pulmonary function and respiratory health by spirometry and questionnaire respectively. Age, years in farming, usual cough, wheezing on most days and nights, bringing up phlegm from the chest, breathlessness, and cigarette smoking were associated significantly with pulmonary function results.

Flachs (2002) concluded that farming has many ongoing situations that can cause stress. The most common stressors for farm families include finances, daily hassles, lack of control over the weather, work overload, and conflict in relationship issues. When faced with a stressful situation one may experience physical symptoms, such as headache or stomach problems. A person becomes depressed or loses temper - emotional

symptoms and behavioral changes like overeating or increased use of alcohol can also be a reaction to stress. Stress affects relationships with others, such as difficulty in getting along, because of irritability or feelings of sadness.

Hansen and Donohoe (2003) describe the socioeconomic conditions of the farm workers. They found that health consequences result from occupational hazards, from poverty, substandard living conditions, migrancy, language and cultural barriers, and impaired access to health care. Specific problems include infectious diseases, chemical and pesticide-related illnesses, dermatitis, heat stress, respiratory conditions, musculoskeletal disorders and traumatic injuries, reproductive health problems, dental diseases, cancer, poor child health, inadequate preventive care and social and mental health problems.

Gomez (2003) studied the prevalence and predictors of joint pain in farmers and farm residents. The 12-month prevalence of joint trouble was: lower back 41.0 per cent, neck/shoulders 35.0 per cent, knees 29.0 per cent, hands/wrists 28.0 per cent, and hips 15.0 per cent. Older age and being female increased the risk of aches, pain, or discomfort in most joints. Doing tractor work was associated with trouble in all five joint areas, and milking was associated with knee trouble. The findings indicate that personal risk factors and the intensity and nature of the farm work contribute to joint trouble.

The main objective of the study done by Holmberg (2004) was to find the prevalence of musculoskeletal symptoms among farmers as compared to rural referents. Data revealed that the farmers reported higher lifetime prevalence of pain in hands

and forearms, low back and hips as compared to the referents. The farmers did not seek medical advice more often than the referents, and they reported significantly fewer sick leaves. Low back pain was associated with musculoskeletal symptoms and with chest discomfort, dyspepsia, symptoms from mucous membranes, skin problems, work-related fever attacks, and primary care for digestive disorders. Presence of both respiratory and digestive disorders doubled the low back pain prevalence.

According to government statistics in Bangladesh, 83.0 per cent of the country's workforce is in agriculture and 62.0 per cent of them are directly involved in agricultural work. They suffer a wide range of accidents that can cause death or leave them disabled. According to a survey by Farm Workers Federation in Bangladesh, rice farming and harvesting is responsible for nearly 11.4 per cent of the accidents; snakebites about 4.5 per cent and power tiller more than 6.6 per cent. All agricultural workers work with bare hands and barefoot and thus expose themselves to injuries from dry shells, snails, sharpened iron and nails that may become fatal. Those who work with straws, jute and cotton fibers, rice dust, chemicals and pesticides are at risk of being afflicted with various types of allergies. Farm workers are also vulnerable to fever, cough and headache. Lack of pure drinking water also causes many diseases. Most of the affected farm workers do not go to hospital or have no access to dependable healthcare services. About four per cent of 3,600 afflicted people sought hospital treatment.

Simpson *et al* (2004) examined associations between perceived psychosocial stress and farm injury among farm men and women. They found that age-standardized rates of injury were 13.3 per 100 per year and 3.8 per 100 per year for men and

women respectively. The most common types of injury were strains/sprains/torn ligaments and cuts/lacerations. Approximately 18 per cent of men and 11.0 per cent of women reported that their lives were "very stressful". Common sources of stress were money worries and feeling overworked. The risk for farm injury increased with level of stress.

Fraser et al (2005) says that farmers experience one of the highest rates of suicide of any industry and there is growing evidence that those involved in farming are at higher risk of developing mental health problems. A literature review was carried out by them that indicated that farmers, farm workers and their respective families face an array of stressors related to the physical environment, structure of farming families and the economic difficulties and uncertainties associated with farming which may be detrimental to their mental health.

### **2.3. Dietary Intake and Nutritional Status**

Nutritional status of 200 female of 19-55 years working at Theni, Tamil Nadu was assessed by Rathna (1994), forty five per cent of them were between the age range of 25-30 years. It was found that women working in ginning mills were in lower socio-economic status their wages are hardly sufficient for basic needs. The mean height of the worker was 153.5 cm and mean weight was 43 kg as per Water low's classification, only 15.5 per cent of workers had standard weight and height, 22.5 per cent of them were mildly malnourished, 38.0 per cent were moderately malnourished and 24.0 per cent were severely malnourished. Only 23 women had normal heamoglobin level of 12-14 g/100 ml blood. The less heamoglobin level is due to fact that dietary intake of iron was found to be half of the ICMR recommended allowances.

Sunanda and Premkumari (1995) studied the nutritional status of 306 adult women aged between 20-46 years and were engaged in in sericulture activities. These women were belonging to three categories of land holdings, marginal, small, and big farmers. The results revealed that mean age at menarche was found to be 13.6 to 14.8 years and inversely proportional to mean age at marriage. Mean age at child birth was ranged

from 17-25 years. Majority of women had low Hb level of 11-12g/100 ml and none had normal hemoglobin level. Majority of women had mean BMI in normal range of 19-29, waist hip ratio showed that 87.0-89.0 per cent of women gluteal femoral obesity and 10.0-11.0 per cent had abdominal obesity.

In a study undertaken by Saxena et al. (1996) to determine the food and nutrient intake of 487 females residing in selected villages, nearly 50.0 per cent of study population was found to be suffering from CED (Chronic Energy Deficient). Poor socio economic status and a low intake of oils and energy were reported to be the contributory factors.

Morbabia *et al.* (1997) presents the variation in dietary intake, according to sex and age, observed among a representative sample of the over-19-years old residents of Canton Geneva (Switzerland). 576 men and 384 women have been interviewed by 2 specially trained dietitians using a dietary history questionnaire (7.9 per cent of the total population). Differences between sexes are essentially a matter of quantities: in grams or kilocalories, men eat more of all nutrients than women. The energetic intake of the males exceeds by 600 kcal the one of the females. This difference is partly due to a mean alcoholic intake of 44 g for the men and 13.7 g for the women. But the per cent of each nutrient in the energetic intake, without alcohol, is the same in both sexes, i.e. 15 +/- 2 per cent of proteins, 40 +/- 6 per cent of lipids and 45 +/- 7 per cent of glucids.

A study was undertaken by Ene-Obong *et al.* (2001) to determine the effects of socio-economic and cultural factors on the health and nutritional status of 300 women of childbearing age in two rural farming communities in Enugu State, Nigeria. The women were engaged in farming, trading, and teaching. A cross-sectional survey was conducted (using both qualitative and quantitative data-collection methods). The teachers had significantly ( $p < 0.05$ ) better health status, health and nutrition knowledge, food habits, nutrient intake, and self-concept, and adhered less to detrimental cultural practices. However, none of the women met their iron, riboflavin, and niacin requirements. More cases of chronic energy deficiency were observed among the farmers (16.0 per cent) and traders (13.0 per cent) than among the teachers (5.0 per cent). The results of the study suggest that the basic determinants of health and nutritional status of women are socioeconomic and cultural, education having a mediating or modifying influence on cultural practices.

The study was designed by McGowan et al (2001) to examine energy intakes (EI), their ratio to estimated basal metabolic rate (BMR) test and the contribution of food groups to energy intake in the North/South Ireland Food Consumption Survey. Random sample of adults from the populations of Northern Ireland and the Republic of Ireland. Food intake data were collected using a 7-day food diary. Body weight and height

were measured and EI/BMR (test) was calculated from reported energy intake and estimated basal metabolic rate. Dieting practices were assessed as part of a self-administered questionnaire. Mean energy intake in men was 11.0 MJ and in women was 7.6 MJ, which is comparable to reported energy intakes in Northern Ireland and the Republic of Ireland over a decade ago. Mean EI/BMR (test) was 1.38. This increased to 1.42 after the exclusion of dieters and those who were unwell, but still remained less than the established cut-off of 1.53. EI/BMR (test) was significantly ( $P < 0.05$ ) higher in men than in women and decreased significantly ( $P < 0.05$ ) with increasing BMI in both sexes. The four food groups that contributed 50 per cent of energy in men and women were meat and meat products, breads and rolls, potatoes and potato products, and biscuits, cakes, pastries and puddings.

A nutritional survey was performed by Bonomo *et al.* (2003) in a random sample of 546 individuals (ages 18 and over) in a city named Bambui (15,000 inhabitants) in Minas Gerais State, Brazil, using the Semi-Quantitative Food Frequency Questionnaire (SFFQ). Median calorie intakes for women and men were 2,807 and 3,775 kcal, respectively. Men consumed four times more alcohol than women, and women consumed more carbohydrates, fiber, and polyunsaturated fatty acids (PUFA). The relative consumption of proteins (15.0 per cent), carbohydrates (57 per cent), and lipids (28.0 per cent) were adequate in both genders. The average proportions, for all participants, of an inadequate share of lipids, saturated fatty acids (SFA), PUFA, and cholesterol in the total calorie intake were, respectively, 36.0 per cent, 90.0 per cent, and 50.0 per cent, and were more pronounced in men than in women

Barquera *et al.* (2003) reported energy and nutrient intake and adequacies in Mexican women. A 24-hour dietary recall was used to obtain nutrient intake in a representative sub-sample of 2,630 women from 12 to 49 years of age from the National Nutrition Survey 1999. Nutrient adequacies were estimated using the Dietary Reference Intakes and stratified according to region, area (urban or rural), socioeconomic status and obesity status (non-obese: BMI  $< 30 \text{ kg/m}^2$ , obese:  $\geq 30 \text{ kg/m}^2$ ). Differences were analyzed using linear regression for complex surveys of log-transformed intake and adequacy, adjusting for multiple comparisons with the Bonferroni test. The median national energy intake was 1,471 kcal. The Risk of Inadequacy (RI) (prevalence of adequacy  $< 50$  per cent) was: vitamin A: 38.3 per cent, vitamin C: 45.5 per cent, and folate: 34.3 per cent. Carbohydrates, folate, iron and calcium intake was significantly higher in rural than in urban areas.

Dietary intake and nutritional status was assessed by Inelmen *et al.* (2004) in a random sample of 190 Italians (70-75 years of age) participating in the Survey in Europe on Nutrition and the Elderly (EURONUT-SENECA). The daily energy intake as assessed by a Modified Dietary History was 2208 $\pm$ 562 Kcal. in men and 1742 $\pm$ 527 Kcal in women.

According to [Agrahar-Murugkara](#) and Pal (2004) dietary intake patterns and socioeconomic variables are well-known indicators for assessing the nutrition status of a society. The Khasi society is matrilineal, and women play an important role in the tribal community, especially with respect to family nutrition. We investigated the existing food habits, beliefs, and trends contributing to the nutrition and health of these women. Nutrient intakes and food sources were studied in 650 Khasi tribal women older than 18 year. Personal interviews using the questionnaire method, 24-h dietary recall method, and food-frequency method were used to elicit information. Respondents were allocated to a low-income group (LIG) or high-income group (HIG). Within these groups, subjects were further classified as non-pregnant and non-lactating (NPNL), pregnant (P), or lactating (L). The dietary pattern was based on rice and cereals (392.48 +/- 13.81 g/d), flesh foods (21.51 +/- 8.63 g/d), green leafy vegetables (110.37 +/- 3.32 g/d), fruits (20.3 +/- 2.10 g/d), and roots and tubers (54.43 +/- 2.92 g/d). Consumption of energy, protein, iron, and vitamin C were adequate except in L women in whom energy levels were significantly lower than the recommended daily allowance in the LIG (2187 +/- 111.12 g/d), protein levels in the LIG (60.85 +/- 4.48 g/d) and the HIG (66.96 +/- 2.99 g/d), iron levels in the LIG (13.64 +/- 1.63), and vitamin C levels in the LIG (66.55 +/- 6.55).

## **2.4. Effect of Anemia and Hemoglobin level on Work Output**

Anemia has a negative impact on the work capacity and performance of subjects of different age group. Iron deficiency impairs work performance and exercise capacity in two ways:

- a- By decreasing the hemoglobin concentration thus affecting the oxygen carrying capacity of blood that impairs aerobic capacity.
- b- By reducing muscular performance due to reduced concentration of iron containing enzymes (Food and Nutrition News, 1997).

In order to assess the impact of anemia on physical work capacity of farmwomen, 40 subjects were selected from Andhra Pradesh Agriculture University, Rajendranagar, physical capacity was assessed by measuring the heart rate responses

of workload on a stepping exercise than normal. A faster recovery in anaemics might be attributed to higher level of habitual physical activity. The disadvantage of lower weight was also found to be compensated by physical activity. It was concluded that physical activity was the lone parameter which had a major role to play in altering efficiency (Shyd and Sharada, 1997).

Nagi and Chadha (1999) studied 100 adult women in age group of 20-40 years belonging to low socio-economic group villages. Phoolanwal and Daad of Ludhiana district. It was found that the diets consumed by the subjects were inadequate with respect to cereal, green leafy vegetables, fats and oils which leads to dietary inadequacy of energy and iron. The haemoglobin, packed cell volume and mean corpuscular heamoglobin concentration indicated that only 5.0 per cent of the subject had acceptable level. The physical work performance as assessed by Harvard step test in respect to rapid fitness index ( $26; 03 \pm 0.43$ ) of all the subjects was poor due to their unsatisfactory iron and negative energy balance.

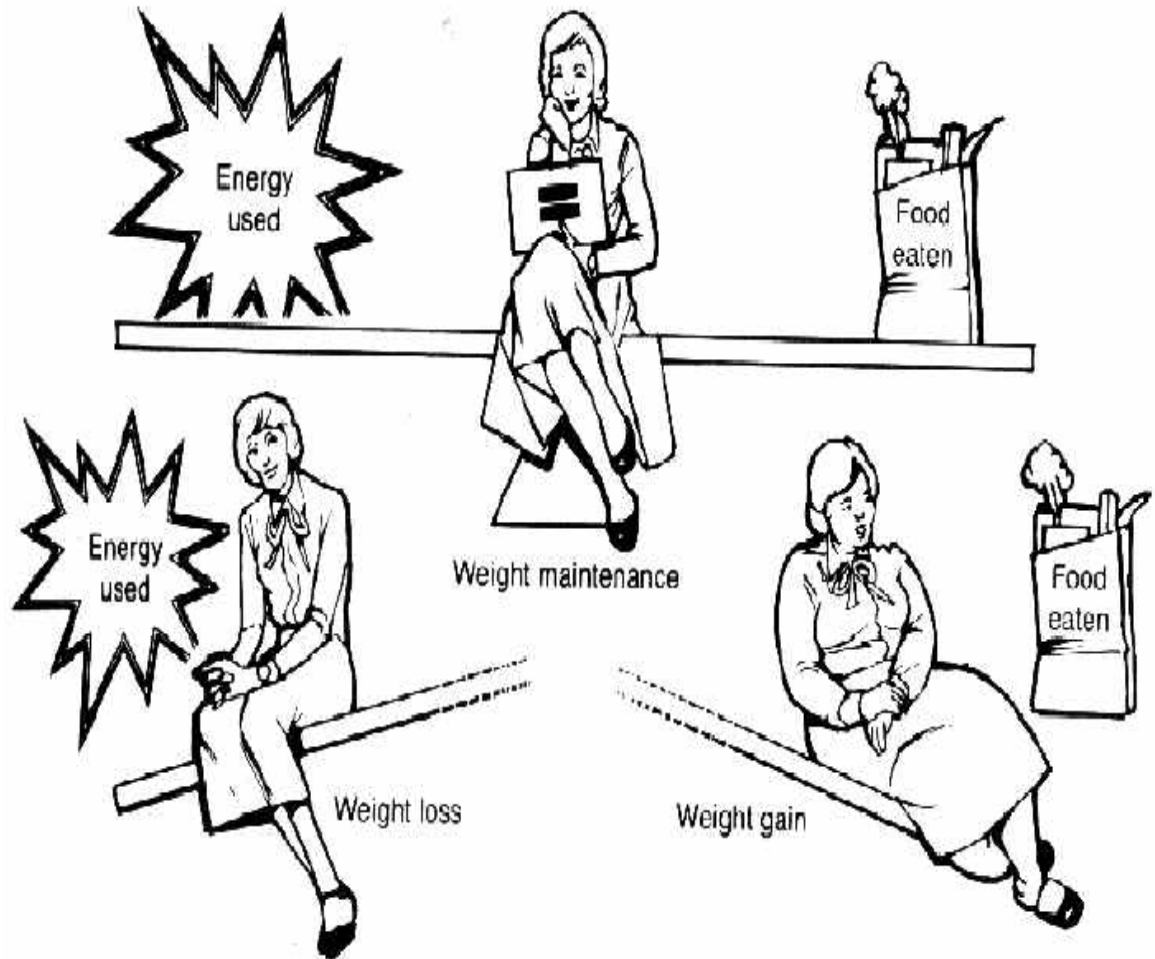
Nutritional status with regard to certain mineral and vitamins can also affect work output. Low levels of circulating heamoglobin due to iron deficiency anemia or vitamin B<sub>12</sub>/folate deficiency aneamia can compromise maximum output (Rao, 1999).

Malville (1991) found the relationship between heamoglobin concentration, nutritional status and working capacity of more than 71 women (age 18-60yrs) living at different altitude in rural area near Kathmandu in Nepal. Half of the women

perform manual wage labour wage daily, the remaining worked only in their own fields or in exchange labour groups. Anemia was mild but wide spread, mean hemoglobin for the total sample was 11.7 (range 7.2-15.6 gm/100m). A step stool was used to measure working capacity. The result showed that lower Hb concentration was correlated significantly with higher heart rate, higher oxygen uptake lower mechanical efficiency, during sub maximal aerobic exercise

Iron intake and status were investigated by [Djazayery](#) (2001) in 471 mothers (age range: 16-53 years) from rural areas in Khorramabad, Islamic Republic of Iran. Although average total iron intake was acceptable, only 6.4 per cent of women derived at least 4.0 per cent of their total intake from animal iron. Average energy and protein intakes were inadequate. Low iron status was seen in 8.2-28.7 per cent, depending on the parameter used, with 28.3 per cent experiencing iron-deficiency anaemia. Significantly higher animal iron intakes were found in literate or employed women, or those of family size fewer than six people. Increasing employment opportunities, income levels and literacy rates for women will result in better iron intake and status and should receive particular attention in national planning.

## 2.6 Energy Balance and Seasonal Variation



**Source: Susan. R. Holman, 1987. Essential of Nutrition for the Health Professionals.**

Choudhary and Jain (1997) studied energy balance in 300 farmwomen of Udaipur district in relation to their nutritional status. In their study energy expenditure was calculated by three different methods i.e. energy cost value by Caltrac, multiple of BMR (FAO /WHO/UNO, 1985) and energy cost values suggested by Bouchard *et al.* 1983 mean TEE (Total Energy Expenditure) of day was 1895 kcal by Caltrac, 2205 Kcal by multiple of BMR and 2523 Kcal by energy cost value.

An investigation was undertaken by Kumar and Parvathi (2001) to estimate the energy expenditure of rural women involved in farming operation through closed circuit indirect calorimetry. Pertinent anthropometric parameters of twelve well-versed women engaged in dry farming operations were measured. Among them two subjects having certain similar and variable anthropometric parameters related to dibbling of seed, crop

thinning, hoeing, cotton harvesting and sunflower stalk pulling operations were selected. The energy expenditure for the different operations was estimated with respect to time through closed circuit indirect calorimetry. The work -rest schedule required for different operations without inducing fatigue on the subject was assessed. The effective working time of the subjects in a day and work-rest ratio for each operation was calculated. The energy expenditure for dibbling seed, crop thinning, hoeing, cotton harvesting and sunflower stalk pulling were estimated as 2024, 2422, 2373, 1526 and 2551 kcal day<sup>-1</sup> respectively. At this level of energy expenditure fatigue induced to the subjects was minimum. The study concluded that dibbling the seed, crop thinning, hoeing and sunflower stalk pulling activities are heavy and inducing fatigue to the women work force.

Aim of the study by Ekelund et al (2002) was to assess total daily energy expenditure (TDEE) and patterns of physical activity among Swedish male and female adolescents and to relate the amount and intensity of physical activity to existing recommendations (energy expenditure equal to or above 12.4 kJ/kg/day or accumulation of 30 min/day in moderate physical activity equal to 4.5 times sedentary energy expenditure or more). TDEE, physical activity level (PAL=TDEE/BMR), energy expenditure (EE) and time spent in different intensities of physical activity were assessed by using minute-by-minute heart rate monitoring in combination with laboratory measured sedentary energy expenditure (SEE) and peak oxygen uptake. Eighty-two 14-15 year old adolescents (42 boys, 40 girls) from the city of Orebro, randomly selected through a two-stage sampling procedure. TDEE was 12.8 MJ/day and 10.0 MJ/day for boys and girls respectively (P<0.001) and PAL was 1.74 and 1.67 (NS). Forty-four per cent and 47 per cent, respectively, of TDEE referred to EE in physical activity, of which 70 per cent for both genders referred to light physical activity (corresponding to <4.5 times SEE). Eleven boys and 14 girls had an EE lower than 12.4 kJ/kg/day and/or did not accumulate 30 min/day in physical activity  $\geq 4.5$  SEE. Those (n=20) with the highest PAL values (>2.01 and 1.81, respectively) spent 149 min/day at a  $\geq 4.5$  SEE intensity level compared to 40 min/day for those (n=30) with the lowest PAL values (<1.55 and 1.45, respectively).

To add to existing knowledge, in a study (Edmundson *et al.* 1998) of eight non pregnant, non lactating female and eight male Hindu village farmers between the ages of 25 and 40 was undertaken, over a period of 32 days of observation. Each activity studied was categorized as productive work, free time, or body maintenance. Journeys to and from the fields, all labour in the fields, house work, child minding, fetching water and tending of cattle, were defined as work, and social and religious activities as free time. Body maintenance included sleeping, eating, grooming, bathing, and defecating. The mean daily energy intakes were 2350 kcal for men and 1852 kcal for women, represented 84 per cent of Indian energy intake recommendations. Where as daily mean expenditure for all men was 2285 kcal and for women it was 1968 kcal. For women it appeared to exceed the mean energy intake. Results showed that women dictated 46.2 per cent of their time (11.1 hours per day) to economically productive work, compared to with an average for men of 33.9 per cent (8.1 hour per day). Including housework, women spent on average 77.6 hours working per week, compared to 57 hours per week for man. However, the number of leisure hours diverged

sharply: men had 27.8 per cent or 6.7 hours of day free, while women have only 14.7 per cent or 3.5 hours leisure per day. It was clear that women allocate more of their time to economic activities than to rest and social activity than did men.

Tin-May-Than, Ba-Aye. (2003) studied the food intake and energy expenditure of ten farmers aged 18-60 years for 3 days in the monsoon season, and for 6 d in harvest and in summer. The mean daily energy intakes  $\pm$  s.e. in the three seasons were 3950  $\pm$  180 kcal (16.8  $\pm$  0.8 MJ), 3690  $\pm$  280 kcal (15.4  $\pm$  1.15 MJ), and 2900  $\pm$  180 kcal (12.5  $\pm$  0.8 MJ), respectively. Energy outputs were 3840  $\pm$  130 kcal (16.05  $\pm$  0.5 MJ) in the monsoon, and 2940  $\pm$  130 kcal (12.3  $\pm$  0.5 MJ) in harvest and 2230  $\pm$  80 kcal (9.3  $\pm$  0.35 MJ) in summer. According to the classification given by FAO/WHO (1973) our Burmese farmers expended energy corresponding to exceptionally active work during the monsoon and harvest, and to light activity during the summer. Nevertheless, their daily intakes at all seasons fulfilled the requirement for very active and exceptionally active work set by FAO/WHO (1973) and also covered their energy expenditure. In contrast to the published values for food consumption of farmers in developing countries, our study shows adequate energy and protein intakes. The study indicates that food intake is not the limiting factor in energy expenditure in this farming community.

A study compared energy stress in three groups of rural women from India, Benin, and Ethiopia, paying particular attention to weight loss and metabolic rate during the “hungry” season. According to Ferro-Luzzi (1990) the differences in food intake between the harvest season i.e. the season of plenty and the lean season were small in all groups, but the differences between groups were much larger. This suggests that energy requirements vary considerably in these three rural regions, undoubtedly reflecting profoundly different pattern of life and work. The seasonal trend in energy intakes revealed a consistent, although not remarkable (6.0 to 8.0 per cent) decline in intake during the lean season.

A study performed by Ategbo *et al.* (1992) body composition, energy intake, energy expenditure, resting metabolic rate (RMR), and energy cost of different activities were measured in three periods per year on 34 female farmers in Northern Benin during two consecutive years. Energy intake showed seasonal fluctuation of approximately 1.7 MJ/d in 1990 and 0.6MJ/d in 1991. Body weight fluctuated between periods, with lowest weight in preharvest periods. Observed changes in body weight were 2.6 $\pm$ 2.3 and 0.9 $\pm$ 1.7 kg in 1990 and 1991, respectively. The same pattern was observed in both fat free mass. RMR, energy cost of different activities, and delta work efficiency did not show any seasonal changes.

Alemer and Lindity (1995) studied physical activity, illness and nutritional status among adults in rural Ethiopian community. The mean body mass index (BMI) (SD) was 19.7 (2.3) for men and 20.0 (2.6) for women. Men showed a significant seasonal variation in estimated energy expenditure that was highest during the pre harvest time. Women did not show such seasonal variations. In a multivariate analysis sex,

age, state of nutrition period, prevalence and severity of disease and season influenced estimated energy expenditure. Both low BMI and illness were significantly associated with low estimated energy expenditure.

In a Tanzanian village, women work 11 hours during the non farming season and almost 14 hours during the farming season. Women contribute more than 40.0 per cent of agricultural labor in 52 developing countries and more than 50.0 per cent in 24 of them. In Gambia, the energy intake of pregnant and lactating women varied from 1250 kcal/day to 1489 kcal/day in the wet season to 1680 kcal/day during the dry season. The energy intake of pregnant female farmers in rural Tanzania was markedly less than their energy expenditure. Low energy intakes among female farmers which led to weight loss were observed during the rainy season of heavy agricultural work (Lukmanji, 1992).

Panter –Brick (1996) evaluated seasonal and sex variation in physical activity levels among agro-pastoralists in Nepal. Total energy expenditure (TEE) was estimated from direct minute by minute by minute observations (totaling 1,679 hours for men, 3601 hours for women) and measured the energy cost of single tasks (117 for men, 168 for women). Men achieved higher PAL than women (PL0.001) both men and women assumed moderately heavy PAL in the winter and very heavy PAL in the monsoon. PAL were 1.88 and 2.22 x BMR for men in respective seasons (CP < 0.005, TEE, 11.8 MJ/d and 13.9 MJ/d) and 1.77 and 2.0 BMR for women (TEE, 9.1 MJ/d and 10.5 MJ/d). High TEE values resulted because of time consuming work in subsistence tasks, most of which were of moderate energy cost. They suggested use of male/female ratio of PAL values instead for population level comparisons for grading levels of energy expenditure.

The energy cost of agricultural and standard activities and the daily energy expenditure of male agricultural workers were measured during different seasons in Iranian villages to assess the validity of past and present Food and Agricultural Organization recommended energy allowances for that population. Studies included low income farmers in a village representative of those around the central desert where harvesting takes place under conditions of extreme summer heat. Measurements were also made during the Moslem fasting period when no food may be eaten between dawn and dusk. Energy cost of typical activities was measured by indirect calorimetry using the Max-Planck respirometer and daily energy expenditure was assessed using these figures combined with a diary of activities throughout the 24-hr period. Results of individual activity values are compared with other published figures. Comparison of daily energy expenditure of fasting subjects and non fasting after Ramazan showed no significant difference. No significant difference was found between values of standardized activities at high summer temperatures and moderate temperatures. Mean values of daily energy expenditure during winter when activity is low are around 2600 kcal/day and for the other seasons of high activity 3400 kcal/day. These figures suggest that past and present Food and Agricultural Organization standards are low for this population.

In an investigation by Bleiberg et al (2002) fifteen female farmers (aged 18-47 years) from two villages of the Mossi Plateau in Upper-Volta participated in a survey in which their daily activity pattern and their energy expenditure were assessed. Eight of the subjects were investigated twice, in March (dry season) when there is no agricultural activity, and in July--August (rainy season) when heavy physical work is performed: mostly hoeing, weeding and replanting sorghum (*Sorghum vulgare*) and millet (*Pennisetum typhoides*). The mean height was 1.57 m and the mean weight 50.6 kg. The average percentage of body fat, calculated from skinfold thickness, was comparable to that of European females but the triceps skinfold was more than 60.0 per cent below the standard value (Jelliffe, 1969). The type of activities and the period of time spent on each activity changed significantly with the season. The mean energy output rose from 9.7 MJ (2320 kcal) in March to 12.1 MJ (2890 kcal) in July-August for a 55 kg standard weight. In this paper, the extent of both the daily activity pattern of women living in subsistence agriculture and their energy output is estimated. The results suggest that during the rainy season, the energy requirements of female farmers are much higher than usually estimated.

A large variation in seasonal weight loss between individuals exists in rural communities in developing countries. Therefore, it was investigated by Schultink et al (2003) whether some individuals show a metabolic adaptation and, through that, prevent large body-weight losses during the pre harvest season. Basal metabolic rate (BMR), energy intake and physical activity level (PAL) of rural Beninese women were measured in three seasons. Groups of subjects were: women with a body mass index (BMI) < 18 (n=18), and BMI > 23 (n=16), and women who had shown small (n=18) and large (n=15) pre harvest weight loss. All groups of subjects decreased energy intake during the pre harvest season by 0.66-1.09 MJ/d. PAL did not show significant seasonal changes in any of the four groups. Only subjects with a BMI < 18 decreased BMR during the pre harvest season with 2.9 (SD 6.7) J/kg per min ( $P < 0.05$ ), with a decrease of 0.8 (SD 1.4) kg ( $P < 0.05$ ) in body weight. In very thin women with a BMI<17 (n=5) BMR expressed per unit body weight decreased even more during the pre harvest season (by 12.0 per cent).

Based on the Murayama (2005) study of anthropometry, energy expenditure and food consumption in four (pre-harvest, harvest, post-harvest and rainy) seasons among rain-fed rice growing farmers in Northeast Thailand, this article clarifies and discusses human adaptive (or maladaptive) strategies to seasonal climatic change. Total energy expenditure fluctuated markedly among the four seasons, but total energy intake did to a negligible extent. Change in body weight significantly differed between pre-harvest and post-harvest seasons, with a magnitude of 1.3 kg, or 2.3 per cent, in males and 2.5 kg, or 4.3 per cent, in females. Respiratory quotient (RQ) was the lowest in the post-harvest season when fat mass increased. These results demonstrated that physiological adaptation, through change in RQ in particular, to change in energy balance occurred in relatively short periods, and thus behavioral adaptation by means of changes in energy intake was observed not in specific seasons but in a year. The nutritional-ecological adaptive patterns of the rain-fed rice farmers were compared with those of various subsistence populations based on physical activity levels.

Thus, on the basis of above review, it can be said that not only in India but in other developing countries, energy intake is less than energy expenditure. Intake of food and nutrients is also inadequate and problem of malnutrition is prevalent.

## 2.4. Relationship between HR and OCR

To define the relation of heart rate to oxygen uptake during weight lifting (WL), heart rate (HR) and oxygen uptake ( $\text{VO}_2$ ) were determined by Collins et al (1991) during bouts of WL at four intensities (40, 50, 60, and 70 per cent of one-repetition maximum (1-RM)) in 15 males. The 11.5-min bouts of WL consisted of three circuits using four exercises (bench press, bent-over row, arm curl, and parallel squat), with each performed for ten repetitions over a 30-s period with a 1:1 work/rest ratio. During lifting at the four intensities, mean ( $\pm$  SE)  $\text{VO}_2$  values were 1.31  $\pm$  0.04, 1.50  $\pm$  0.07, 1.72  $\pm$  0.07, and 1.86  $\pm$  0.08  $\text{l}\cdot\text{min}^{-1}$ , or 33.0-47.0 per cent of treadmill-determined  $\text{VO}_2$  max. Mean ( $\pm$  SE) HR values were 124  $\pm$  4, 134  $\pm$  4, 148  $\pm$  5, and 161  $\pm$  4  $\text{beats}\cdot\text{min}^{-1}$ , or 63-82 per cent of maximal HR. The slope of the linear regression equation predicting % $\text{VO}_2$  max from %HR max ( $Y = 0.582X - 1.7911$ ,  $r = 0.86$ ,  $\text{SEE} = 3.4$  per cent) was approximately half that reported for dynamic low-resistance exercise such as running or cycling. At a given % HR max, % $\text{VO}_2$  max was consistently lower than predicted for dynamic low-resistance exercise. It was concluded that the HR/  $\text{VO}_2$  relationship during dynamic high-resistance exercise for intensities between 40.0 and 70.0 per cent of 1-RM is linear but is different from that reported for dynamic low-resistance exercise.

The study by Teh (2002) describes the heart rate and oxygen uptake responses during, and the intensity and caloric cost of, ascending and descending a public-access staircase. Subjects were initially assessed for their maximum oxygen uptake and heart rate on a treadmill in the laboratory. For field measurements, subjects ascended ( $N = 103$ ) and descended ( $N = 49$ ) 11 stories of 180 steps, each step of 15 cm in height, for a total vertical displacement of 27.0 m. The mean oxygen uptake and heart rate during the last 30 s of ascending were 33.5  $\pm$  4.8  $\text{mL kg}^{-1}\cdot\text{min}^{-1}$  and 159  $\pm$  15  $\text{b}\cdot\text{min}^{-1}$ , respectively. During the descent, oxygen uptake and heart rate during the last 30 s of the climb were 17.0  $\pm$  3.8  $\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  and 107  $\pm$  18  $\text{b}\cdot\text{min}^{-1}$ , respectively. The caloric cost of stepping up and down a step was calculated to be 0.11 and 0.05 kcal, respectively.

To compare the effects of forward walking (FW) and backward walking (BW) on heart rate (HR) and oxygen consumption ( $\text{VO}_2$ ) at treadmill grades of 5.0 per cent, 7.5 per cent, and 10.0 per cent a study was conducted by Hooper et al (2004). Previous studies of locomotion by humans on a treadmill have reported larger cardiovascular exertion and potential biomechanical benefits of BW as compared to FW for treadmill grades ranging from 0 per cent to 5.0 per cent. The present study extends these findings by examining the cardiovascular effects of BW and FW at treadmill grades greater than 5.0 per cent.  $\text{VO}_2$  and HR were measured using open-circuit calorimetry and electrocardiogram, respectively. For both forward and backward walking, subjects performed each of the 3 grades for 6 minutes, during which HR and  $\text{VO}_2$  were measured. Two-way repeated-measures ANOVAs were employed for inferential statistical analysis. Percent maximum heart rate (HR (max)) and per cent maximum oxygen consumption ( $\text{VO}_2$  max) increased

incrementally for treadmill grades of 5.0 per cent to 7.5 per cent to 10.0 per cent for both FW and BW ( $P < .00001$ ). For each of the 3 treadmill grades, per cent HR (max) and per cent  $VO_2$  (max) was 17.0 per cent to 20.0 per cent higher for BW than for FW ( $P < .00001$ ). No statistically significant interactions were detected between direction of walking and treadmill grade.

# ***METHODOLOGY***

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The present research was undertaken to study the energy intake, expenditure, its balance, nutritional status, and occupational health hazards faced by farmwomen. The details of methodology followed for the present study is explained below:

## **3.1. Locale of the study**

## **3.2. Sample selection**

## **3.3. Work Plan**

### **Phase-I**

#### **3.3.1. Background Information**

#### **3.3.2. Activity Schedule**

#### **3.3.3. Occupational hazards faced by farmwomen**

#### **3.3.4. Anthropometry of the respondents**

### **Phase-II**

#### **3.3.5. Dietary survey**

#### **3.3.6. Haemoglobin estimation**

#### **3.3.7. Assessment of Energy Expenditure and Energy Balance**

#### **3.3.8. Assessment of Physiological Workload through Treadmill Exercise**

## **3.4 Analysis of Data**

## **3.1. Locale of the study**

The present study was conducted in villages adopted by National Agriculture Technology Project/All India Coordinated Research Project, College of Home Science, MPUAT, Udaipur. The villages were Parakhet, Bhoiyon ki Pancholi, Dangiyon ki Pancholi, Kanpurkhara and Kharbadia in the Girwa Panchyat samiti of Udaipur. The investigator purposively chose to work in these villages as good rapport was established with beneficiaries due to institutional activities; which facilitated good response by the respondents.

Udaipur is located in the southern part of Rajasthan surrounded by Rajsamand and Pali district in north, Dungarpur and Banswara on the southern side, Chittaurgarh on the eastern side and western side by Sirohi district of Rajasthan. Udaipur district has population of 26,32,210 (Census, 2001) living in 2248 villages of 11 blocks which constitutes 4.66 per cent of the states population. It is spread over 12511 sq. kms accounting 3.65 per cent of the total area of the state. Population density is 196 person/ sq. km higher than state average of 165 persons/ sq. km. District is divided into four sub-divisions Jhadol, Salumber, Udaipur and Vallabhnagar, which includes ten tehsils. There are ten developmental blocks covering 498 Gram panchayats. The district has extreme temperature with maximum temperature recorded as 43.9° C and minimum as 2.9°C and annual rainfall as 43.42 cm (District statistical abstracts, 2000).

Main crops of this area are:

**Kharif crops:** Pearl millets, cluster beans, sesame, green gram and maize.

**Rabi crops:** Wheat, mustard, chick peas and barley.

## **3.2. Sample Selection**

For the present study a sample of 90 non-pregnant, non-lactating farmwomen, not suffering from any chronic disease and engaged in agricultural activities for last 10 years were selected purposively i.e. 30 subjects in each landholding category viz. small farmer (SF), marginal farmer (MF) and landless agricultural laborers (LAL).

## **3.3. Work Plan and Data Collection**

### **Phase –I**

For the first phase of plan of work, data from the entire 90 respondents were collected on following aspects:

### **3.3.1 Background information:**

For collecting background information of respondents, an interview schedule was prepared to elicit general information pertaining age, years of participation in agriculture, type and size of family and type of landholding.

### **3.3.2 Activity Schedule**

Activity schedule of the respondents in both lean (April-May) and peak agriculture season (November-December) was gathered using observation cum recall method. Observation was done on three different weekdays between 8.00 am to 5.00 pm and activity schedule for rest of the day was recorded by recall method. For the assessment of total time spent on various activities, an activity questionnaire was used to determine time spent in various physical activities. Questions were asked to determine as accurately as possible how much physical activity is involved in household tasks, occupational and leisure time activities and so on. After taking all the points in consideration, a detailed record of time spent on each of the activity was noted. This procedure provided an accurate estimate of the length of time spent daily on each activity by the subject.

### **3.3.3. Occupational health hazards among farmwomen**

**a-** An Interview schedule was prepared to procure data on type of hazards in each of farm activities carried during Peak season viz. land preparation, sowing, weeding and harvesting (Appendix-II).

**b-** For assessment occupational health problems faced by farmwomen, a Scale for Assessment of Occupational Health Hazards (SAOHH) among farmwomen (Singh and Sinwal, 2005) was used (Appendix-I). This scale consists of 30 statements with following reliability and validity:

**Reliability of the scale**

By split half method -93% at 0.01 level of significance

By test retest method-88% at 0.01 level of significance

**Validity of the scale**

By split half method-96% at 0.01 level of significance

By test retest method-93% at 0.01 level of significance

**Instruction for Use of the Scale:**

Interview method was used as farm women are illiterate. Explain each statement carefully and asked them to give answer in five degree. In this (4) denotes 'Always' (3) denotes 'Often' (2) denotes 'Sometimes' (1) denotes 'Rarely' and (0) denotes 'Never'.

*The scores obtained on scale were used to ascertain hazard proneness of respondents as per classification given below:*

<i>Score range</i>	<i>Hazard proneness</i>
0 – 30	Low incidence of hazards
31 – 60	Moderate incidence of hazards
61 – 90	High incidence of hazards
91 – 120	Severe incidence of hazards

**3.3.4. Anthropometry of the respondents**

The pattern of growth and physical state of the body are profoundly influenced by diet and nutrition. Body measurements which are simple and easy to measure at the same time giving maximum information on nutritional status were chosen for the present study.

**Weight:** It is most commonly used anthropometric measurement. Weight is made up of muscles, fat, skeleton and internal organs It indicates the current nutritional status (Jelliffe, 1966).

**Technique for taking weight:** A platform spring balance was used for measuring weight. The subject was asked to stand in the center of the platform barefoot, with minimum cloths and without touching anything else.

**Interpretation:**

The weight observed was compared with the 50th percentile of NCHS (1977) standard for 18 years as no standard values for adults of this age are available. The prevalence of malnutrition was assessed as per the classification suggested by McLaren (1976):

Body Weight as% of Standard	Grade of Malnutrition
<60	Severe malnutrition
60-80	Moderate malnutrition
80-90	Mild malnutrition
90-110	Normal
110-120	Over nutrition
>120	Obese

**Height:** The height of an individual is sum of four components i.e. leg, pelvic, spine and skull (Beal, 1980). It is less fluctuating and can be used as a criterion to quantify chronic malnutrition.

**Technique for taking height:**

The height was measured with a vertical anthropometric rod. After removing shoes subject was asked to stand on the flat floor, erect with both heels together and hand hanging by the sides. The subject was made to look straight and it was ensured that the inferior orbital margin and the tarsus of the ear fall in the same horizontal plane parallel to ground. The head piece of the rod which consisted of a metal bar was gently lowered touching the hairs and making its contact with the top of head.

**Interpretation:**

The height measured was than be compared with NCHS (1977) standards for adult men and women. The classification suggested by McLaren (1976) was used:

Standard	Interpretation	Height as % of
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<80 %	Dwarf
80-93	Short
93-105	Normal
>105	Giant

**Body Mass Index (Quetlet’s Index):**

The Body Mass Index is a reliable indicator of nutritional status and size of body fat stored in adult population. The index was calculated by dividing the absolute weight (kg) with absolute height (meters) squared (Garrow 1987) i.e.

$$\text{BMI (kg/m}^2\text{)} = \text{Weight (kg)} / \text{Height}^2 \text{ (m)}$$

The data obtained was compared with following Body Mass Index classification given below:

**Body Mass Index classification**

<b>Presumptive diagnosis</b>	<b>BMI</b>
Chronic Energy Deficiency- grade III severe	< 16.0
Chronic Energy Deficiency- grade II moderate	16.0 -17.0
Chronic Energy Deficiency- grade I mild	17- 18.5
Low weight- normal	18.5-20.0
Normal	20.0-25.0
Obese grade I	25.0-30.0
Obese grade II	>30

BMI is used to assess the nutritional status of adults. Low BMI is a result of chronic malnutrition right from childhood and can also lead to lower work output. This has many socio-economic implications since such undernourished workers tend to be lethargic and avoid strenuous work. Industrial and agricultural output and consequently earning by such undernourished population will tend to be low (Rao, 1999).

**Phase-II**

On the basis of BMI a sub sample of 18 subjects was selected i.e. six women from each landholding category representing the different grades of BMI i.e. obese, normal and CED as indicated below:

**Body Mass Index classification**

<b>Presumptive diagnosis</b>	<b>BMI</b>
Chronic Energy Deficiency (CED)	< 18.5
Normal	18.5-25.0
Obese grade	> 25.5

### 3.3.5. Dietary survey

During both lean and peak seasons dietary survey by 24 hour recall method was conducted using the standardized cup set to find out the intake of various foods in different meals of the day. The information about raw quantity taken for cooking as well as the cooked quantity prepared for the whole family and consumption of cooked food by the subject was recorded in terms of household measures/ numbers/ kg to find out the quantum of raw food intake. From the cooked and raw amount of foods, the raw amount consumed by each subject was then calculated using formula:

$$\text{Raw amount consumed by each subject (gm)} = \frac{\text{Total raw amount of each ingredient (gm)}}{\text{Total cooked amount (gm)}} \times \text{Individual intake of cooked amount (gm)}$$

The adequacy of diet was assessed in terms of type of food consumed and the intake of nutrient. The details regarding the consumption of various food items and food groups like cereals, pulses, nuts and seeds, oil and fats, fruits and vegetables, milk and milk products, flesh etc. were recorded. The intake of the food was compared with the average intake as given by National Institute of Nutrition (1998). Diet composition was assessed in terms of intake of nutrients and per cent of energy in the diet. The nutrient content of these diet was calculated using Nutritive Values of Indian Foods (Gopalan et al., 1989). Iron, Energy (Kcal) and the nutrients contributing energy i.e. protein (gm), carbohydrate (gm), and fat (both visible and invisible fat content) (gm) of the diet per day was calculated separately and compared with RDA suggested by NIN (1998). Energy was calculated using physiological fuel values of carbohydrate, fat and protein. The Atwater Bryant factor or physiological fuel value are as follows:

<b>Nutrients</b>	<b>Heat of Combustion</b>	<b>Coefficient of digestibility</b>	<b>Digestibility percent</b>	<b>Physiological fuel value (Kcal)</b>
<b>Carbohydrate</b>	4.1	0.98	98	4.0
<b>Fat</b>	9.45	0.95	95	9.0
<b>Protein</b>	5.65	0.92	92	4.0

Source: Robinson C.H., Marilyn R., and Lawler (1982)

Normal and Therapeutic Nutrition

### 3.3.6. Haemoglobin Estimation

Nutritional status, with regard to certain minerals and vitamins can also affect work output. Low levels of circulatory Haemoglobin due to iron deficiency anaemia or vitamin B<sub>12</sub>/folate deficiency anaemia can compromise maximum output (Rao, 1999). The Haemoglobin level was estimated for all the 18 subjects as Haemoglobin is the principle component of red blood cells and account for most of the iron in the body. It acts as carrier of oxygen from lungs to tissues. Haemoglobin estimation is important indicator for assessment of anemia. As anemia may compromise even normal activity and work output due to reduced oxygen uptake capacity of the blood.

For the present study, Haemoglobin level was estimated with the help of expert and the method used is given in Appendix-III. It was classified according to WHO classification (Sachdeva and Choudhary, 1994). Grades of anemia were assessed as per the categories given below:

#### Classification of Anemia as per Haemoglobin level

Haemoglobin level (g/dl)	Interpretation
<7	Severe Anemia
7-9.9	Moderate Anemia
10-11.9	Mild Anemia
≥12	Normal

### 3.3.7. Assessment of Energy Expenditure and balance during lean and peak agriculture seasons

The energy cost of different activities have been suggested by various investigators (Antia, 1982; Consalzio et al. 1963; Davidson et al, 1973; Durnin and Passmore, 1967; Lawrence et al, 1984; Swaminathan, 1983) but there is no similarity as some have given in terms of energy need and other in terms of energy expenditure. Some investigators have estimated energy cost inclusive of BMR and others have estimated exclusive of BMR. Moreover, the similar activities have been categorized differently under light, moderate, vigorous, and strenuous activities etc and energy cost is given only for the categories. On the other hand energy cost for light, moderate and heavy activities are given, but activities included in these are not specified. The units to express the energy cost of activities are also different. Some expressed it in Kcal/kg/10 min/15 min and other represented in terms of Kcal/hour and kJ/min irrespective of body weight

or energy cost are given for particular body weight. Thus, there is a difference in energy cost of even a specific activity and number of and type of activities listed for energy costs also vary from investigator to investigator. So, this simplified approach with two principle component of energy expenditure: BMR and physical activity was used.

For the calculation of Energy Expenditure Rate (EER) for every activity performed through out the day during these seasons, heart rate values of all 18 subjects using **POLAR heart rate monitor** was recorded.

Procedure used for recording Heart rate for every minute was as follows:

- After preparing the subject for the experiment the subjects were asked to sit in a relaxed position and data of resting for 5 minutes was recorded.
- Then the subject was asked to do the activity and data for 20 minutes (if the duration of activity was longer than 30 minutes) and the data for complete activity (if the duration of activity was less than 30 minutes) was recorded.
- Immediately after the termination of the activity the subjects were given rest and recovery heart rate was taken after 5 minutes for 5 minute duration.

Heart Rate and Energy expenditure was measured or estimated for the following activities and tasks, listed in alphabetical order:

Cutting and collecting fodder: The activity was divided into cutting fodder, bundling, backward and onward journey. So the HR values for cutting, collecting were recorded for 20 minutes.

Carrying loads: On the head, with the arms, or both; differences in the manner of carrying the load were minimal and values were therefore combined. HR for 20 minutes was recorded.

Child care: Bathing, changing, and dressing children and helping them to move about.

Chopping wood: wood 2 to 4 inches in diameter and dried tree branches were chopped with a machete (long-blade knife weighing 2-3 lb); only the actual cost of chopping was measured.

Cleaning animal shed: The activity consisted brooming, collecting dung and transporting it to disposal site. The combined HR data for all three activities was recorded for complete cycle.

Cooking: Over wood fires using virtually no labour-saving devices. Typical activities included cutting of vegetables; preparing chapatti, rab (which entailed walking within the house to get the grain, walking to an

outside water-tap to draw water, carrying the pot to the fire, and cleaning place where food was cooked. Environmental temperature in the cooking area was usually 36°C or higher. data for 20 min was recorded.

Eating: Seated on floor the majority of the time, occasionally getting up to serve food to family members.

Feeding Animals: The activity included giving fodder and water to the animals. The activity was performed 3-5 times a day except in rainy season but, the data was recorded once for complete activity.

Harvesting: The crop of wheat is harvested when the grains harden and the straw becomes dry and brittle. Most of the respondents used sickle for cutting wheat. The HR data for 20 minutes was recorded.

House-cleaning: This is a general category for household duties that accounts for a large portion of the women's work-day. It included dusting, folding clothes, shaking out straw sleeping mats, collecting clothes for washing, and "putting things in order." It can be considered as "random standing," as more standing than walking was involved.

Land Preparation: The first step for cultivating crop is preparing the field. A well pulverized but compact seedbed is required for good and uniform germination. Land preparation usually comprises of cleaning and leveling of field, stubble collection, manure and fertilizer application, ploughing, harrowing and planking operations. The activity is performed during the months of October -November when the temperature remains between 12-20<sup>0</sup> C.

Lying down: Energy expenditure was measured after 15 minutes in this position.

Personal necessities: Dressing and undressing, hair-combing, bathing, and walking to an "out-house" to urinate or defecate.

Making dung cake: HR data for 30 minutes was recorded.

Milking: Data for milking were recorded for the complete activity.

Sowing: The manual work during sowing seeds, especially material handling, may involve considerable physical loads on the part of the worker. While sowing wheat the temperature ranges between 28-30<sup>0</sup> C. The survey revealed that sowing of wheat was done by few respondents with seed-drills that were tractor or bullock-drawn. In most of the places, seeds were sown by Kera/ pora method in which a person pour seeds

with hand in furrows behind the plough or in the iron tubes attached for this purpose. The man does the ploughing and the women walked behind the plough putting seeds and fertilizer.

Sweeping: With a broom. Earth floors of the houses were sprinkled with water prior to sweeping. Data for 20 minutes was recorded.

Walking: As measured on local terrain, while ascending and descending mild slopes or on a flat surface. Generally, the women walked at a pace of about 4 km per hour.

Washing dishes: Included lifting full buckets of water and vigorous scrubbing with coarse sand to remove grease and particles from pans and dishes. This activity was repeated 4-5 times a day but, data was recorded only once for complete activity.

Washing clothes: By hand, either in a concrete slab with a textured scrubbing surface or at a river. The rinsing of clothes was performed at the slab by scooping water and pouring it over the soaped clothes, whereas at the river clothing was dunked several times into the current. The women worked less continuously at the slab to allow for re-filling of the water-tank. Nevertheless, there was no difference in the amounts of energy expended using either method. Dirt was removed from the clothes by the women's physical force and weight against the roughness of the slab's surface or the rocks in the river; virtually no detergent and only mild vegetable soaps were used. The procedure consisted of wetting the clothes, soaping, scrubbing (anchoring the cloth with one hand and scrubbing with a back-and-forth motion using the others, rinsing and wringing; with heavy or exceptionally dirty clothing, both hands were used to scrub and the procedure was akin to kneading a tough piece of dough.

Weeding: Stooping to cut weeds with a sickle, between rows of maize.

After collecting data of HR for every activity performed in a day during lean and peak season it was used to calculate **Energy Expenditure Rate (EER)** of each activity carried out by the women using the following formula given by Varghese *et al.* (1995):

$$\text{Energy expenditure rate (kJ/min)} = \text{HR (beats/min)} \times 0.159 - 8.72$$

**Total Energy Expenditure (TEE)** on each activity was calculated using energy expenditure rate of the activity as given below:

$$\text{TEE (kJ)} = \text{Energy expenditure rate (kJ/min)} \times \text{Time spent (min)}$$

**Calculation of Total Daily Energy Expenditure (TDEE):**

To calculate total daily energy expenditure, energy expenditure on each and every activity of the day was added with Basal Metabolic Rate (BMR) of the subject:

$$\text{TDEE} = \text{Energy expenditure on each activity through out the day} + \text{BMR}$$

Basal Metabolic Rate (BMR) was estimated as Harris-Benedict (1919) equation:

$$655 + (9.56 \times \text{weight in kg}) + (1.85 \times \text{height in cm}) - (4.67 \times \text{age in years})$$

Physiological Cost of Work (PCW) was calculated using following formula:

$$\text{Physiological cost of work} = \frac{\text{Total Cardiac Cost of Work}}{\text{Total time of work}}$$

Total Cardiac Cost of Work (TCCW) was calculated using formula given below:

$$\begin{aligned} \text{TCCW} &= \text{Cardiac Cost of Work (CCW)} + \text{Cardiac Cost of Rest (CCR)} \\ \text{CCW} &= \text{Average Heart Rate (AHR)} \times \text{Duration} \\ \text{AHR} &= \text{Average Working Heart Rate} - \text{Average Resting Heart Rate} \\ \text{CCR} &= \text{Average Recovery HR} - \text{Average Resting HR} \times \text{Duration} \end{aligned}$$

Total energy expenditure and energy intake in lean and peak agriculture seasons was compared after calculating energy balance as:

$$\text{Energy Balance} = \text{Energy Intake} - \text{Energy Expenditure}$$

### 3.3.8. Assessment of Physiological Workload through Treadmill Exercise

The sustained physical activities, the aerobic capacity, i.e. maximum oxygen consumption rate ( $\text{VO}_2 \text{ max}$ ) of a worker sets the limit for his/her maximum performance. Physical work performed by the human body is accomplished by muscular contractions, supported by oxidative metabolic process in the muscle cell, in which fuel (essential carbohydrate, protein and fat) is oxidized in presence of oxygen. Oxygen uptake, therefore, is an expression of energy output or rate of work (Rodahl, 1989). Considering this, the most important determinant of endurance fitness is the maximum oxygen uptake or aerobic power or physical work capacity (a liter of oxygen uptake per minute). It is also expressed as percentage of the individual's maximum aerobic power that is how much of individual's maximum aerobic power has to be taxed in order to complete the work with exhaustion. Most of the reported work on determination of aerobic capacity was on men (Saha. et. al, 1978 and Nag and Chhaterjee, 1981). A study on aerobic capacity was also conducted by Chhaterjee et, al, 2005 on sedentary female university students of same socio-economic background and

suggested a regression equation for predicting oxygen uptake. However, no study on determination of aerobic capacity of farm women has been conducted. Considering this, an experiment on treadmill was designed using sub-maximal workload technique for determining the aerobic capacity of farmwomen and also to develop regression equations for estimating oxygen consumption at their known heart rate. The protocol of the experiment for sub-maximal exercise for 18 subjects selected on basis of BMI is given as under:

- Determine the maximum heart rate (MHR) of each worker by equation given by Robergs and Landwehr (2002);

$$\text{MHR} = 205.8(0.685 \times \text{age})$$

- One day training to the subjects on treadmill at different speed and slope.
- Prior to start of experiment, preliminary warm up was carried out for 15 minutes and followed by rest of five minutes to each subject.
- The exercise schedule of 30 minutes for each worker at different speed of treadmill is given below:

Speed on Tread mill for each worker					
2.5 km/h		3.5 km/h		4.5 km/h	
Slope %	Duration (minutes)	Slope %	Duration (minutes)	Slope %	Duration (minutes)
0	3	9	3	15	3
3	3	12	3	18	3
6	3	15	3	21	3
9	3	-	-	-	-
<b>Total</b>	<b>12</b>	<b>Total</b>	<b>9</b>	<b>Total</b>	<b>9</b>

The decided speed of tread mill was based on the field experiment, where they perform various farm operations at various speed varying from 2.5 to 4.5 km/hour. The work load for each subject was increased stepwise at intervals of 3 minutes on slope until exhaustion as suggested by Rodhal (1989). An ambulatory metabolic measuring system (Cortex Metamax-3X) was used to measure heart rate and oxygen consumption rate of subject during sub maximal exercise on the tread mill.

The observed data of heart rate and oxygen uptake at all speeds for each worker were noted. Statistical treatment of the data obtained was carried out. The data were plotted on graph for extrapolation of oxygen uptake at maximal heart rate. After determining the aerobic capacity of each worker, it was divided by their body weight and aerobic capacity in ml/kg-body mass/min was estimated. For calculating the aerobic capacity and oxygen consumed at various heart rates the estimated oxygen uptake at heart rate of 110, 120, 130, 140, 150, 160, 170, 180 beats/min for subjects from CED, Normal and Obese category was plotted and regression equation was developed.

Thus, four regression equations developed for farmwomen from different BMI categories viz. CED, Normal and obese category and also a general equation for farmwomen. This would be a unique contribution in the area of ergonomic research for estimating oxygen consumption (y) at their known heart rate (x) during various agriculture operations.

The relationship between physiological workload in terms of heart rate and aerobic capacity (during sub-maximal workload on treadmill) and nutritional status in terms of weight Haemoglobin level, iron, protein intake, and energy intake was determined using co-relation coefficient.

### 3.4. Analysis of data

In order to analyze the data both quantitative and qualitative measures were adopted. The data collected was processed, tabulated, classified and analyzed using different stastical methods.

- **Percentage and Mean** distribution was analyzed to quantify the general information of the family and subject.
- **Mean Percent Scores** of the respondents reporting different hazards was calculated using the formula:

$$\text{MPS} = \frac{\sum n_1 + n_2 + n_3 \dots \dots \dots n_x}{\text{Total no. of respondents}}$$

- **Mean ± standard deviation** was calculated to assess the various form of malnutrition and health hazards present in study group.
- **Co-relation Coefficient** was calculated to establish relationship between Body Mass Index and Hazard Proneness of the respondents.
- **Paired t-test** was used to find the significance of difference between season

$$t = \frac{\bar{d} \sum \sqrt{(n)}}{S} \quad \text{at } n-1 \text{ degree of freedom}$$

Where  $\bar{d} = \frac{\sum d}{n}$  and

- **Standard Deviation** was calculated using the formula:

$$\text{SD} = \frac{\sqrt{\{\sum d^2 - n (\bar{d})^2\}}}{n - 1}$$

# ***SUMMARY AND CONCLUSION***

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India's ancient scripture ascribed a divine status to women. Laxmi, Durga, and Saraswati are three great goddesses of prosperity, power and wisdom. The ancient scripture declared that GOD live where women are worshipped. According to Swaminathan (1985) some historian believed that it was women who first domesticated crop plants and thereby initiated the art and science of farming. While men went out for hunting in search of food, women started gathering seeds from the native flora and began cultivating those of interest from the point of view of food, feed, fodder, fiber, and fuel.

That women play a significant and crucial role in agricultural development and allied fields including crop production, livestock production, horticulture, agro/social forestry, fisheries etc. is a fact long for taken for granted and also ignored. The nature and extent of involvement in agriculture, no doubt, varies widely among different ecological sub-zones, farming system, caste, classes, and stages in the family cycle. But regardless of these variations there is hardly any activity in agricultural production, except ploughing, in which women are not actively involved. In a World Report (1985) on women Ruth Sivyard writes that "Women's work does not count" is a commonly accepted fact by every unit of society. What the society does not realize is that housework is the most productive and the most arduous work, women do. Again housework is not the only work women do but, they virtually do all the household work, three quarters of other agricultural work and half of the work with animals. Taken together women work over three times as much as men.

In India, although women perform many fold tasks at working sites as well as at home, even a major portion of food is served first to adult males whether earning or not. The remaining amount of food is than distributed to women and children of the family although earning. As a results diet becomes deficient not only quantitatively but also qualitatively. Nutrition plays an important role in the efficiency and welfare of worker as adequate diets are essential for optimum output. Work either light or heavy calls for additional supply of energy or other nutrients. Low intakes of nutrient reduce the physical capacity to work and increase the extent of fatigue accident rate and sickness. Improvement in work efficiency and output require adequate diet, sufficient not only in calories but also protein, minerals and vitamins which must be made available. But women are discriminated against in access to basic necessities such as food and medical care. When family resources are meager, the short fall in the women's food intake is likely to be twice as high as for the male members of the household. Amongst children, consistently higher proportions of girls are found to be malnourished, with the situation particularly acute amongst the landless families. Giving the link between nutritional deficiency and susceptibility to infection, this leads on to a higher incidence of illness amongst female children, which coupled with less access to medical treatment for girls,

results in higher mortality rates for young girls than for boys. Among adults, a greater percentage of women than men receive no medical treatment in the event of illness and among those treated, the reliance on traditional medicine is higher amongst women whereas men receive more expensive modern medical treatment (Abdullah et al., 1985).

Thus, an overview of data emphasizes that women's access to food within the family or household is below desired levels and significantly less than that of men's. Also, women's energy intake is below their expenditure levels, where as men from the same poor families have intakes equal, or exceeding their expenditure level. The sector that must be given the most importance is being given the least importance. Through the proposed study the investigator endeavored to bring out physiological workload in terms of energy expenditure (EE) of farmwomen in various household and agricultural activities in lean and peak agricultural seasons.

### **Objectives**

1. To assess nutritional profile of farmwomen.
2. To assess occupational health problems faced by farmwomen.
3. To compare the physiological workload of farmwomen in lean and peak agricultural seasons.
4. To find out relationship between physiological workload and nutritional intake of farmwomen.

### **Methodology:**

The present study was conducted in villages Parakhet, Bhoiyon ki Pancholi, Dangiyon ki Pancholi, Kanpurkhera and Kharbadia in the Girwa Panchyat samiti of Udaipur district. On a sample of 90 non-pregnant, non-lactating farmwomen, not suffering from any chronic disease and engaged in agricultural activities from last 10 years were selected purposively i.e. 30 subjects in each landholding category viz. small farmer (SF), marginal farmer (MF) and landless agricultural laborers (LAL).

For collecting background information of respondents, an interview schedule was prepared. Activity schedule of the respondents in both lean (April-May) and peak agriculture season (November-December) was gathered using observation cum recall method. An Interview schedule was prepared to procure data on type of hazards in each of farm activities carried during Peak season viz. land preparation, sowing, weeding and harvesting. For assessment of hazard proneness of farmwomen, a Scale for Assessment of Occupational Health Hazards (SAOHH) among farmwomen (Singh and Sinwal, 2005) was used. Body measurements which are simple and easy to measure at the same time giving maximum information on nutritional status were chosen viz height and weight. Body Mass Index was calculated as per Garrow (1987)  $\text{BMI (kg/m}^2\text{)} = \text{Weight (kg)/ Height}^2 \text{ (m)}$ ,

On the basis of BMI classification a sub sample of 18 subjects was selected i.e. six women from each landholding category representing the different grades of BMI i.e. obese, normal and CED. Dietary survey by 24 hour recall method was conducted using the standardized cup set to find out the intake of various foods in different meals of the day during both lean and peak seasons. Haemoglobin level of these subjects was estimated with the help of expert. The adequacy of diet was assessed in terms of type of food consumed and the intake of nutrient. The details regarding the consumption of various food items and food groups like cereals, pulses, nuts and seeds, oil and fats, fruits and vegetables, milk and milk products, flesh etc. were recorded. The intake of the food was compared with the average intake as given by National Institute of Nutrition (1998). Diet composition was assessed in terms of intake of nutrients and per cent of energy in the diet. Iron, Energy (Kcal) and the nutrients contributing energy i.e. protein (gm), carbohydrate (gm), and fat (gms) including both visible and invisible fat content of the diet per day was calculated separately and compared with RDA suggested by NIN (1998). Energy was calculated using physiological fuel values of carbohydrate, fat and protein.

For the calculation of Energy Expenditure Rate (EER) of the subjects for every activity performed throughout the day during these seasons, heart rate values of all 18 subjects using **POLAR heart rate monitor** was recorded. After collecting data of HR for every activity performed in a day during lean and peak season it was used to calculate **Energy Expenditure Rate (EER)** of each activity carried out by the women using the following formula given by Varghese *et al.* (1995):

$$\text{Energy expenditure rate (kJ/min)} = \text{HR (beats/min)} \times 0.159 - 8.72$$

**Total Energy Expenditure (TEE)** on each activity was calculated using energy expenditure rate of the activity multiplied by time spent on it in minutes as given below:

$$\text{TEE (kJ)} = \text{Energy expenditure rate (kJ/min)} \times \text{Time spent (min)}$$

**Calculation of Total Energy Expenditure of the Day (TEED):**

To calculate total daily energy expenditure, energy expenditure on each and every activity of the day was added with Basal Metabolic Rate (BMR) of the subject:

$$\text{TDEE} = \text{TEE of each activity through out the day} + \text{BMR}$$

Energy Balance was calculated during lean and peak season as:

$$\text{Energy Balance} = \text{Energy intake} - \text{Energy Expenditure}$$

To assess the physiological workload of the respondents an experiment on treadmill was designed using sub-maximal workload technique for determining the aerobic capacity of farmwomen and also to develop regression equations for estimating oxygen consumption at their known heart rate. For calculating the aerobic capacity and oxygen consumed at various heart rates the estimated oxygen uptake at heart rate of 110-180 beats/min for subjects from CED, Normal and Obese category was plotted and regression equation

was developed for farmwomen from different BMI class viz. CED, Normal and obese and also a general equation for farmwomen. The relationship between physiological workload in terms of heart rate and aerobic capacity (during sub-maximal workload on treadmill) and nutritional status in terms of weight, haemoglobin level, iron, protein intake, and energy intake was also determined using co-relation coefficient.

## **Results and Discussion**

### **A- Background Information**

The background information of the respondents depicts that majority of the respondents (75%) were in young age group i.e. below 40 years and majority of respondents in all categories (i.e. 63.33 percent of LAL, 43.34 percent of MF and 36.67 percent of SF) were engaged in agriculture activities for about 15 years. Approximately half (49%) of them were from joint and rest (51%) were from nuclear families. Nearly three fourth of the total respondents from all the categories (73 LAL, 70 percent of MF and 63 percent of SF) were from medium size families with 5-10 members. A vast majority from MF (93.44%) and SF (100%) had irrigated land.

### **B- Participation of Women in Farm, Allied (dairy) and Household Activities**

Women play a significant role in farming and management activities. These women participate in most of the agriculture activities like manuring, land preparation, sowing, weeding, transplanting, hoeing applying fertilizer taking care of standing crops, harvesting, threshing, carrying the produce from farm to home, and storage of food grains. in activities like weeding, land preparation, sowing, threshing, harvesting, maize shelling, groundnut decortications and uprooting of seedlings participation of farmwomen was 100 percent which was unaffected by land holding status. Whereas, time devoted

to different activities by respondents of different land holdings was varying as in maize shelling and groundnut decortications time spent by LAL, MF was 240 min per day whereas it was just half i.e. 120 min per day for respondents of SF. And same difference was in time contributed in sowing threshing and harvesting it was 480 min/day in LAL and MF and 240 min/day in SF. Main allied activity carried out by the respondents was animal husbandry. As livestock development has always been a major concern in the Indian economy along with agriculture. Animal care is the domain of farm women. Housework (childcare and house hold chores) and economically extended work (i.e. fetching of water and fuel and making of cow dung cakes) which is crucial for family's survival, is still exclusively a women's responsibility. Except for fetching fuel, it was the female children who extended a helping hand to their mothers for the above tasks. Women absolutely do not get any help from their men folk for domestic activities and economically extended activities.

### **C- Hazard Proneness of the Respondents**

Highest percentage of respondents i.e. 60 percent (LAL 50%, MF 60%, and SF 70%) fell in the category of 'moderate' incidence of health hazard while 30 percent (LAL 33%, MF 33% and SF 23%) of total respondents were exposed to 'high' category of hazard proneness and remaining 10 percent were in the severe category of hazard proneness. Significant fact observed was that no respondent was reported to be in the 'low' category of health hazards. BMI and hazard proneness of the subjects were negatively correlated which means that as BMI decreases the incidence of hazard proneness increases.

Farmers suffer from a variety of health hazards. Hazard represents the harm to the health of mankind either physically or mentally due to work, work method or condition, environment, implements or tools used for work, also plants and animals in the surroundings. In the present investigation health hazards have been identified for the following selected agricultural activities -

**Land preparation:** It was clear from the data that fatigue, body pain, cuts, thorny puncture in hands and feet ranked first, second and third respectively with majority of respondents confronting these hazards while preparing fields for any type of crops. Next to these approximately 20-30 per cent of the farm workers had the problem of headache and dizziness during land preparation and confronted the hazards of injury and poisonous organism bites.

**Sowing:** While performing this activity they mostly experienced physiological health hazards. Both pain in body and fatigue were the major hazards acclaimed by almost all the respondents and ranked on the top. Headache and dizziness ranked second and injury due to the tools and equipment ranked third and can be said as key health hazards of sowing.

**Weeding:** Respondents mostly faced mechanical hazards like injuries. Tools and equipment used for work may be held responsible for injuries during weeding.

**Harvesting:** The major hazards in harvesting it can be said that body pain ranked first, followed by fatigue and skin problem confronted by maximum number of respondents. And lowest was environmental hazards.

## **D- Nutritional Profile of the Respondents**

## **1-Anthropometry of the Respondents**

The classification of height as the percent of standard depicts that less than half (44%) of the respondents from all the categories were normal in height. Only one fourth (25%) of the total respondents were normal in weight. less than half (47% in LAL and 43% SF) of the respondents fell in normal grade of BMI (Body Mass Index), while 57 percent of MF had normal BMI, and ample no of the respondents were either chronic energy deficient (33% in LAL, 20% in MF and 30% in SF) or obese (20% in LAL, 23% in MF and 26% in SF), which clearly indicates some kind of nutritional imbalance.

## **2-Dietary Adequacy**

The general dietary pattern of farmwomen revealed that three meal pattern was followed by most of the women. Almost all the women were taking tea with or without chapatti (roti). Some of them were taking milk instead of tea.

Dietary Intake of 18 farmwomen, selected on the basis of BMI, was studied for their daily food intake by 24 hours recall method. It was revealed that the diet of the farmwomen from all the landholding categories in both the seasons was notably inadequate with comparison to balance diet in all the food groups except that of cereals, roots and tubers, milk and milk products. Daily diet of farmwomen from different land holding categories was cereal based with little consumption of other food items. The daily consumption of almost all the food items in all the landholding categories was slightly higher during peak season than in lean season. But the difference was non significant in all the food groups.

**Energy Intake** in LAL was 11260 kJ/day (92 % of RDA), in MF it was 10294 kJ/day (84% of RDA) and in SF it was 10996 kJ/day (90% of RDA) in lean season. Whereas, during peak season energy intake was 11541, 11408 and 10691 kJ/day in LAL, MF and SF respectively, which was 94, 93 and 87 percent

of RDA (12168 kJ/day). NIN 1998, have suggested contribution of 10-12, 20-25, and 60-70 percent respectively from protein, fat and carbohydrate in a balance diet. It was 10.6, 14.3 and 74.9 percent of total energy intake during lean agriculture season from protein, fat and carbohydrate respectively and in peak season it was protein (10.9%), fat (13.2%) and carbohydrate (75.9%) of the total energy intake. The contribution of energy from protein was same as per NIN (1998) in both seasons but contribution of energy from fat was lower and carbohydrate was higher in the study group than that suggested by NIN, it may be due to higher intake of cereals and potato and low consumption of fats and oils, reason being high cost and low purchasing power.

Average protein intake was 72, 70, and 71 grams/day in respondents from LAL, MF and SF respectively during lean season; it was 144, 140 and 142 percent of RDA. Whereas; in peak agriculture season the daily intake of protein was 74, 72 and 72 grams/day which was 148, 144 and 144 percent of RDA (20 grams). Difference in daily intake during lean and peak season was non-significant.

Visible fat intake was 13.7, 14.15 and 13 grams respectively in respondents of LAL, MF and SF during lean season and which was about 68, 70 and 66 percent of RDA (20 gms/day) and during peak season the fat intake was 13, 15.15 and 15.9 grams/day which was 65, 75 and 79.5 percent of RDA respectively in LAL, MF and SF categories. But, the difference was non-significant between intake of fat during lean and peak agricultural season in all the three categories of land holding.

Mean intake of carbohydrate in respondents of LAL, MF and SF was 515, 508 and 489 grams respectively in lean season. Whereas, in peak season it was slightly higher than lean season in LAL intake was 525 grams, in MF 517 grams and in SF it was 491 grams/day. Difference in intake during lean and peak season for all categories was non-significant.

### **3-Haemoglobin Level**

No respondent from any of the land holding categories were normal and all were suffering from some degree of anemia. In LAL 66 percent, MF 100 percent and SF 83 percent were suffering from moderate anemia. And very few LAL (34%) and SF (17%) were suffering from mild anemia.

### **D- Energy Expenditure of the respondents**

Energy Expenditure was calculated from heart rate data of the activities.

**1-Agriculture activities:** In Land Preparation average energy expenditure was highest in MF (4485kJ/day) because average time devoted to the activity by them was highest i.e. 443minutes/day. In Sowing, average working heart rate (AWHR), time spent and energy expenditure (EE) on the activity was highest in LAL i.e. 93 beats/minute, 448 minutes/day and 2730 kJ/day. In Weeding AWHR was almost equal in all the categories of landholdings 108 beats/min in LAL and MF and 110 beats/min in SF. AEER was almost equal in all three categories but, energy expenditure was highest in LAL 3348 kJ/day. AWHR was highest in SF i.e. 118 beats/min. Whereas, EE was highest in LAL (4058 kJ/day) followed by MF (3200 kJ/min) and lowest was in SF (1476

kJ/min) as time spent on the activity was also decreasing in the same order i.e. 433, 346 and 146 min/day in LAL, MF and SF respectively.

It emphasized the fact that energy expenditure was highest for every activity among respondents of LAL and the probable reason was they spent more time on all agriculture activities because they worked as paid labourer and had to work for 8 hours or more per day. And among all activities AWHR was highest in land preparation, followed by weeding, than harvesting and lowest in sowing. Energy expenditure also followed same pattern i.e. highest in land preparation (3668 kJ/day) and lowest in sowing (1648 kJ/day). More time was spent on land preparation but lowest on weeding. In nut shell it can be concluded that, land preparation was most time consuming, labour consuming and heavy activity followed by harvesting, weeding and sowing which was least time and labour consuming.

**2-Allied (Dairy) Activity:** In Cutting and Collecting Fodder AWHR (121 beats/min), time spent (87 minutes in lean season and 57 minutes in peak season), AEER (10.6 kJ/min), EE/day (925 kJ), TCCW (933 beats) and PCW (31 beats/minute) was almost equal for all respondents from all land holding categories. For cleaning animal shed on an average AWHR, AEER, time spent, EE, TCCW and PCW was 112 beats/minute, 9.1 kJ/minute, 30 minutes, 268 kJ/day, 754 beats and 25.23 beats/minute, respectively. In Milking AWHR (112.7 beats/min), AEER (9.2 kJ/min), time spent (40 min), EE (368 kJ/day), TCCW (770 beats) and PCW (25.7 beats/min) were almost same for all the respondents. For feeding animals on

an average AWHR was (84.5 beats/min), AEER (4.7 kJ/min), time spent (46 min in lean season and 25 min in peak season) was same for all categories. For making dung cakes AWHR was approximately same in all categories, LAL (84.7 beats), MF (85.8 beats/min) and SF (87.3 beats/min), AEER was 4.7, 5.1 and 5.2 kJ/min respectively in LAL, MF and SF, time spent was same (30 minutes) during lean and peak seasons in all categories.

**3-Household activities:** From daily performed household activities cooking was most time consuming (120 min/day in lean season) whereas; washing clothes and fetching water were most energy consuming activities with AWHR 113 beats/min and 114 beats/min and lowest AWHR and EER was observed in personal care (80 beats/min) and child care (81 beats/min). Cutting and collecting wood was the most energy (4906 kJ/day) and time consuming (480 min/day) activity in weekly performed activities.

#### **F- Total Daily Energy Expenditure (TDEE)**

**1-Lean Season:** Persual of data explained that washing clothes among household activities was most energy consuming (838 kJ/day) activity and fodder cutting was most energy consuming (926 kJ day) activity in dairy, irrespective of landholding categories. Cooking (625 kJ), fetching water (569 kJ), sweeping (602 kJ) were also amongst high energy demanding activities. Whereas; child care (258 kJ) and personal care (241 kJ) were comparatively low energy demanding activities. Highest total energy expenditure was among MF (11056 kJ/day), followed by LAL (11041 kJ/day) and lowest was in SF (10793 kJ/day). And in BMI categories

highest TEED was in Obese (11750 kJ in LAL, 12339 in MF and 11535 in SF), followed by Normal (11185 kJ in LAL, 10629 kJ in MF and 10986 kJ in SF) and lowest in CED (10188 kJ in LAL, 10199 kJ in MF and 9858 kJ in SF).

**2-Peak season:** Farm women toil hard in labour from early morning till late night. Demand on their time and energy increases all the more in peak agriculture season, as during this period in addition to completion of time bound agriculture action there is no escape from daily chores. Highest TDEE was at the time of Land preparation activity (12446 kJ/day) it was depicted that from LAL category women in CED grade spent maximum total energy per day (11839 kJ/day) during land preparation. Obese women from all the land holding categories except LAL spent highest total energy (13361 kJ in MF and 11451 kJ in SF) from their counterparts with normal and CED grade of BMI. Second highest TDEE was in weeding (10947 kJ/day), woman from LAL categories spent maximum mean energy (3573 kJ) in weeding as respondents from this category are hired. This was followed by MF category (1935 kJ) and than SF (1251 kJ). At the third rank was harvesting (10708 kJ/day) similar results as weeding were observed, the LAL category spent maximum energy per day in harvesting activities (3897 kJ/day) as compared to the respondents from MF (3123 kJ/day) and SF (1470 kJ/day) category of landholding. Lowest TDEE was observed during the time of sowing (10449 kJ) it was evident that in sowing activity respondents from LAL category spent maximum energy per day (2688 kJ/) as compared to respondents from MF (1218 kJ) and SF (1032 kJ).

It was evident that 40-50 percent was spent in maintaining Basal Metabolic Rate (BMR) of the body. The energy input by the respondents varied with activity in peak season. The maximum percentage of TDEE was in land preparation (29%), followed by Harvesting (29%), than Weeding (20%) and lowest demanding was sowing (16%) but, they do not refrain from routine activity and spend maximum energy (33% of TEED) in it during sowing season. A common phenomenon observed in all seasons was that, if the percent energy expenditure was less in peak season activity the corresponding energy expenditure percent increased in routine activity. This clearly signifies that about 52-60 percent of TDEE was spent by respondents in daily activities whether it was routine or peak agriculture activity and rest 40-50 percent in maintaining BMR.

### **G-Energy Balance**

When energy expenditure is equal to energy intake it is called energy balance whereas, if energy expenditure exceeds energy intake than it shows negative energy balance and if energy expenditure is lower than energy intake than it shows positive energy balance. Energy balance was positive during lean season irrespective of BMI class. In Peak season Energy balance was positive during Sowing and Weeding, and balance was negative during Land preparation and harvesting

### **H-Physiological Work Load of the subjects**

#### **1-Maximum Heart Rate and Aerobic Capacity of the Subjects**

The observed data of heart rate and oxygen uptake at all speeds and slope for all categories of BMI during Sub-maximal experiment conducted in a controlled environment of laboratory on computerized tread mill shows that with

increasing grade HR and OCR also increased in linear fashion in all categories of BMI. The data when plotted on graph for extrapolation of oxygen uptake ( $VO_2$  max/ aerobic capacity) at maximal heart rate (MHR) shows that the MHR was  $185.14 \pm 2.25$  beats/min in subjects of CED,  $184.45 \pm 2.2$  in Normal category and  $180.80 \pm 2.46$  beats/min in subjects of Obese category. The aerobic capacity ( $VO_2$  max) was  $1.11 \pm 0.32$  l/min ( $26.4 \pm 7.43$  ml/kg/min) in CED,  $1.25 \pm 0.03$  l/min ( $24.071 \pm 2.24$  ml/kg/min) in subjects of Normal BMI class and  $1.07 \pm 0.12$  l/min ( $16.480 \pm 2.85$  ml/kg/min) in subjects of Obese category.

**2-Relationship between Physiological workload and Nutritional Profile of the Subjects:** The study clearly depicted that Maximum Heart Rate (MHR), Aerobic capacity ( $VO_2$  max) and exercise time decreased with increase in age in all the respondents from all BMI class. MHR and  $VO_2$  max increased with weight in CED and decreased with weight in Obese whereas; Exercise time decreased with increasing body weight in all respondents of all BMI classes. Maximum Heart Rate, Aerobic capacity and exercise time increased with increase in intake of protein, iron and energy in all BMI classes. And the same trend was emphasized in Haemoglobin level that means as Haemoglobin level raised MHR and  $VO_2$  max also raised in same manner in all categories of BMI (Body Mass Index). It can be concluded that as nutritional status, BMI improves, capacity of work also increases. Person gets less tired and productivity is increased. Whereas, with increase in age and weight capacity of person to do work decreases.

**3-Regression equation:** Following equations were suggested for calculating oxygen consumption (y) at their known heart rate (x) during various agriculture operations.

$$y = 0.007 x - 0.301$$

for CED

$$y = 0.0081 x - 0.271$$

for Normal

$$y = 0.0069 x - 0.251$$

for Obese

$$y = 0.0086 x - 0.469$$

for General

There was non-significant difference in estimated and calculated values of oxygen consumption from regression equation at increasing heart rate (110-180 beats/min).

**Conclusion:** Therefore, it can be said that diet of farmwomen is deficient in terms of energy, protein and iron. Due to which the physical work capacity is decreased. Agriculture possesses many occupational health hazards to the workers. And their hazard proneness is also correlated with their nutritional status in terms of Body Mass Index. As Body Mass Index of a person decreases their health hazard proneness increases.

Total daily energy expenditure shows that 40-50 percent of the total energy expenditure was on Basal Metabolic Rate and remaining that is about 52-60 percent of TDEE was spent by respondents in daily activities whether it was routine or peak agriculture activity.

Energy balance in lean season, during sowing was positive in all the respondents of various land holding categories and BMI

classes. And was negative during harvesting, land preparation and weeding activity of peak season. It can be said that the homeostatic mechanism which controls and regulates energy balance involves a complex and long term lag mechanism; it is true for the farmwomen of the present study. Obesity is associated with age, education, and reproductive factors in women. Obesity represents a more complex entity where psychological and genetic factors that are difficult to assess may be more important.

## **RESULTS AND**

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### **DISCUSSIONS**

The present chapter describes the results and their interpretations in context with objectives for the study. The findings were described under the following headings:

#### **4.1 Background Information of the respondents**

#### **4.2 Participation of women in farm, allied (dairy) and household activities.**

#### **4.3 Occupational health hazards faced by women farmers**

##### **4.3.1. Hazard proneness of the subjects**

##### **4.3.2. Health hazards in selected agricultural activities**

#### **4.4 Nutritional Profile of the Respondent**

##### **4.4.1. Anthropometry of the Respondents**

##### **4.4.2. Dietary adequacy**

##### **4.4.3. Haemoglobin Level**

#### **4.5 Energy Expenditure**

##### **4.5.1. Agriculture activities**

##### **4.5.2. Allied (dairy) activities**

##### **4.5.3. Household activities**

#### **4.6. Total Daily Energy Expenditure**

##### **4.6.1. Lean Season**

##### **4.6.2. Peak Season**

#### **4.7. Energy Balance**

##### **4.7.1. Lean Season**

##### **4.7.2. Peak Season**

#### **4.8. Physiological Workload of the Respondents**

#### **4.8.1. Maximum Heart Rate and Aerobic Capacity of the Subjects**

#### **4.8.2. Relationship between Physiological Workload and Nutritional Profile**

#### **4.8.3. Regression Equation**

## **4.1 Background Information of the Respondents**

To get an overview of the profile of the respondents, data regarding their age, type and size of the family, landholding, years of participation in agriculture are presented below:

### **4.1.1. Age of the respondents**

The age of the respondents was ascertained by date of birth if known otherwise by the age at the time of marriage, number of children and their ages. It was observed that the majority of the respondents from landless agriculture labour (50.0%) and marginal farmer (43.4%) fall in young age group of 25-30 years and very few (3.3%) from these categories were in the older age group of 40-45 years. More than half of the respondents (56.7%) in small farmer category were below 40 years of age while remaining was above 40 years of age (Figure-1).

**Table-1 Percentage distribution of the respondent's age**

<b>Age groups ( in years)</b>	<b>LAL (n=30)</b>	<b>MF (n=30)</b>	<b>SF (n=30)</b>	<b>Total N=90</b>
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25-30	50.0 (15)	43.4 (13)	20.0 (6)	37.8 (34)
30-35	26.7 (8)	23.4 (7)	20.0 (6)	23.4 (21)
35-40	10.0 (3)	16.7 (5)	16.7 (5)	14.5 (13)
40-45	10.0 (3)	13.3 (4)	26.7 (8)	16.7 (15)
45-50	3.3 (1)	3.3 (1)	16.7 (5)	7.8 (7)

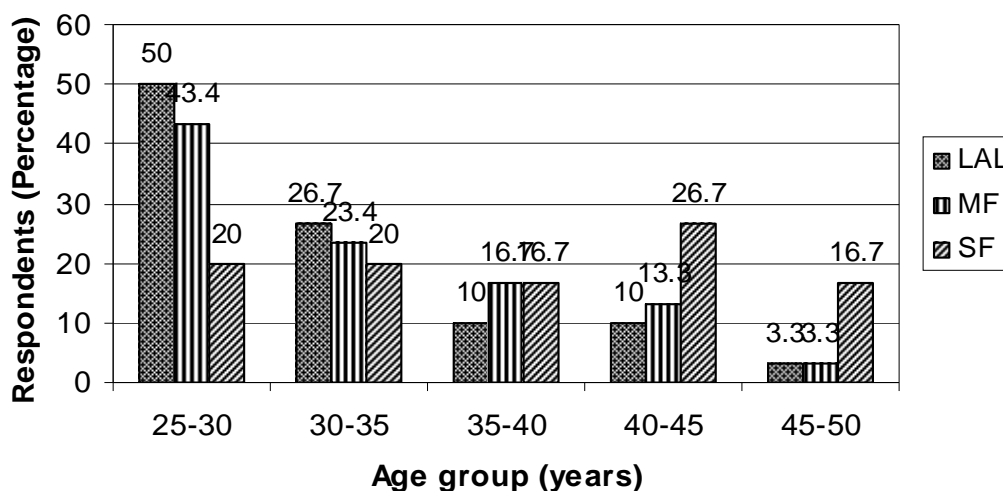
Figure in parenthesis depicts no. of the respondents

Overall data as can be seen from Table-1 depicts that majority of the respondents (75.7%) were in young age group below 40 years.

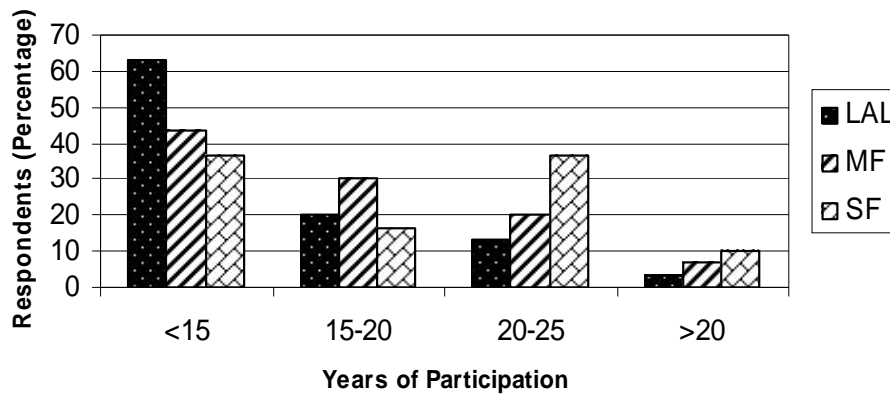
#### 4.1.2 Years of Participation in the Agriculture

It is evident from Table-2 that majority of respondents in all categories (i.e. 63.3 percent of LAL, 43.3 percent of MF and 36.7 percent of SF) were engaged in agriculture activities for about 15 years and about 20.0 per cent were involved in agriculture for more than 25 years.

Figure. 1 Percentage distribution of age of the respondents



**Figure.2. Percent distribution of respondents on the basis of years of participation in agriculture**



**Table-2 Percentage distribution of the respondents on the basis of years of participation in the agriculture**

Years of Participation	LAL (n=30)	MF (n=30)	SF (n=30)	Total (N=90)
<15	63.3 (19)	43.3 (13)	36.7 (11)	47.8 (43)
15-20	20.0 (6)	30 (9)	16.7 (5)	22.2 (20)
20-25	13.3 (4)	20 (6)	36.7 (11)	23.3 (21)
>25	3.3 (1)	6.7 (2)	10.0 (3)	6.7 (6)

Figure in parenthesis show no. of the respondents

#### **4.1.3 Type and size of the family of the respondents**

Table-3 depicts that approximately equal numbers of the respondents were from joint (51.1%) and nuclear (48.9%) families.

**Table-3 Type and size of the family of the respondents**

Parameters	Landholding Categories			Total (N=30)
	LAL (n=30)	MF (n=30)	SF (n=30)	
<b>Type of family</b>				
<b>Nuclear</b>	46.7 (14)	53.3 (16)	46.7 (14)	48.9 (44)
<b>Joint</b>	53.3 (16)	46.7 (14)	53.3 (16)	51.1 (46)
<b>Size of the family (no. of members)</b>				
<5	6.7 (2)	6.7 (2)	3.3 (1)	5.5 (5)
5-10	73.3 (22)	70.0 (21)	63.3 (19)	68.9 (62)
10-15	20.0 (6)	20.0 (6)	33.3 (10)	24.4 (22)
>15	0	0	0	0

Figure in parenthesis shows no. of the respondents

With regard to the size of the family, majority (94.0%) had medium size families and only 5.5 per cent had small size families with less than 5 members. Nearly three fourth of the total respondents from all the categories (73.3 per cent of LAL, 70.0 per cent of MF and 63.3 per cent of SF) belonged to medium size families with 5-10 members (Figure-3).

Figure-3 Percentage distribution of the respondents according to type of the family

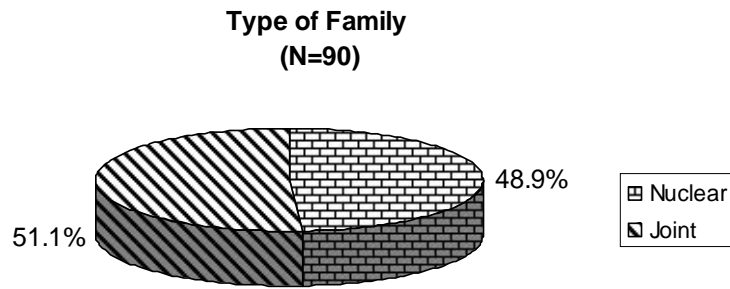


Figure-4 Number of family members (size of the family)

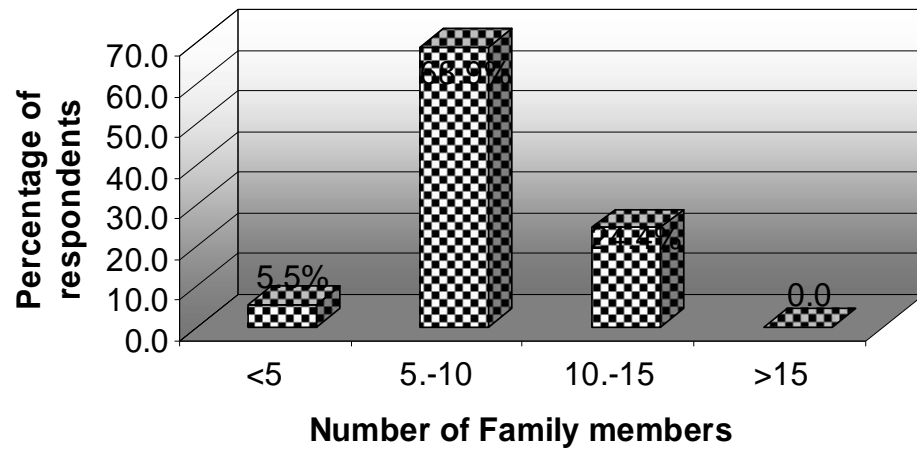
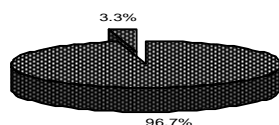


Figure-5 Type of land of the respondents



#### 4.1.4 Type of the Land of the respondents

The data in Table-4 revealed that a vast majority from MF (93.44%) and SF (100%) had irrigated land.

**Table-4 Type of land of the respondents**

Type of land	Landholding Categories		Total N=60
	MF (n=30)	SF (n=30)	
Irrigated	93.3 (28)	100 (30)	96.7 (58)
Unirrigated	6.7 (2)	0	3.3 (2)

#### 4.2.

**Participation of women in farm, allied (dairy) and household activities.**

##### 4.2.1. Involvement of women in agricultural activities

Women play a significant role in farming and management activities. A large number of farm women are engaged in farming operations either as cultivators or helpers to

cultivators or agriculture labours. These women participate in most of the agriculture activities like:

**a. Weeding**

Weeding was performed by all the respondents of all the land holding categories for 480 minutes/day for about 30 day in a year that means 30 man days/year (1man day=8 hours).

**b. Top dressing of fertilizer**

The activity was performed by 83.0 per cent LAL for about 120 minutes/day for about 15 days/year (approximately 4 man day/year), in MF 17.0 per cent and in SF 35.0 per cent of respondents perform it for 120 min/day for 5days/year (1.25 man day/year).

Table- 5 Percentage distribution of respondents performing agriculture activities

Agriculture Activities	Categories of land holding											
	LAL (n=30)				MF (n=30)				SF (n=30)			
	Performance	Time spent minutes/day	No. of days/yr	Man** days/yr	Performance	Time spent minutes/day	No. of days	Man days /yr	Performance	Time spent minutes/day	No. of days	Man days/yr
<b>Weeding</b>	100	480	30	30	100	480	30	30	100	480	20	20
<b>Top dressing of fertilizer</b>	83	120	15	3.75	17	120	5	1.25	35	120	5	1.25
<b>Maize shelling</b>	100	240	20	10	100	240	10	5	100	120	10	2.50
<b>Groundnut decortiations</b>	100	240	10	5	100	240	10	5	100	240	10	5
<b>Uprooting of seedlings</b>	100	240	10	5	100	240	5	2.50	0	0	0	0
<b>Land preparation</b>	100	480	30	30	100	480	20	20	100	480	10	10
<b>Preparing tillage</b>	100	480	20	20	100	480	10	10	35	480	7	7
<b>Manuring</b>	17	480	5	5	35	480	5	5	0	0	0	0
<b>Sowing</b>	100*	480	10	10	100*	480	5	5	35*	180	6	2
<b>Irrigation</b>	17*	240	48	24	35*	240	10	5	0	0	0	0
<b>Threshing</b>	100*	480	20	20	100*	480	5	5	100*	240	4	2
<b>Harvesting</b>	100	480	60	60	100	480	30	30	100	240	20	10

\* Jointly with male member

\*\* One man day= 8 hours

### **c. Maize Shelling**

Maize shelling was done by more or less all the respondents irrespective of landholding categories for 240 minutes/day. But LAL perform it for 20 days/year (10 man day/year), MF and SF were doing it for 10 days/year (5 man days/year).

### **d. Groundnut Decortifications**

It was performed by all the respondents for 240 min/day for 10 days in a year (5 man days/year) in all landholding categories.

### **e. Uprooting of seedlings**

It was done by all the respondents of LAL and MF category for 240 min/day for 10 days in year which makes 5 man day/year.

### **f. Land Preparation**

The activity of land preparation is most important and is first step for cultivating crop. It was performed for 480 min/day and for 30 man days/year by respondent from LAL. MF perform it for 480min/day for 20 man day and SF for 10 man days/year.

### **g. Preparing tillage**

It was performed by all the respondents of LAL and SF and only 35.0 per cent of SF for 480 min/day but LAL did it for 20 man days/year, MF 10 man days and SF 7 man days/year.

### **h. Manuring**

In this activity involvement of women farmer was lower than other activities i.e. 17.0 per cent from LAL and 35.0 per cent of MF were doing the activity for 480 min/day for respectively 20 and 10 man days/year.

#### **i. Sowing**

Sowing was done by all the respondents of LAL and MF for 480min/day and respectively 10 and 5 man days/years.

#### **j. Irrigation**

In irrigation involvement of women was low i.e. 17.0 and 35.0 per cent respectively in LAL and MF for 240 min/day.

#### **k. Threshing**

In threshing activity women act as helper of male. It was done by entire respondent all the categories for 480 min/day in LAL and MF categories and 240 min/day in SF.

#### **l. Harvesting**

Harvesting is solely women's responsibility and involvement of all the respondent was 100 percent for 480 min/day for 60 man days/year in LAL and MF and 240 min/day in SF for 10 man days/year.

In a study confined to women engaged in agricultural operation conducted by Shobha et.al (2007) in Chittoor district of Andhra Pradesh; a total of 14 villages were selected randomly. The basis of selection was main source of livelihood i.e. agriculture, 138 respondents were selected. A one hundred percent of women belonging to lower socio-

economic group being landless had to perform all labour intensive activities such as transplanting, weeding, harvesting and winnowing. More than 50 percent performed sowing, threshing involving muscular activity; therefore, women generally were assisted by men in this task.

#### **4.2.2. Involvement of women in allied activities**

Main allied activity carried out by the respondents was animal husbandry. As livestock development has always been a major concern in the Indian economy along with agriculture. Animal care is the domain of farm women. The soft, easy and feminine character activities like animal husbandry operation have been dominated by farmwomen for long. Researches point out that most drudgery ridden tasks in this area are collecting and bringing fodder, chaffing fodder, milking, collecting dung, making cow dung cakes, cleaning animal shed and feeding animals and these are mainly performed by women (Table-6).

##### **a. Fodder cutting**

This activity consists of cutting fodder, bundling, backward and onward journey. Cent per cent respondents from LAL and MF and 83.0 percent of SF were concerned in the activity in both the seasons but time committed to the activity was more in lean season i.e. 90 minutes and 60 minutes in the peak season, which, was comparatively less than lean season. The reason being the time spent in onward and backward journeys was not counted during peak season (Table-6).

##### **b. Cleaning animal shed**

Cleaning of shed assumed great importance as unhygienic conditions invite a host of diseases to animals coupled with low milk production. Apart from this, cleaning of cattle shed requires considerable time and effort of farm women. For cleaning of shed brooms were used, which, weighted 500 gm. Through brooming they could gather waste at the rate of 8 kg/hour. They used hands for picking up dung and other waste in squatting posture and a basin called "tagari" in local dialect was used for transporting the waste to disposal site. The weight of tagari was 2.50 kg and they could gather about 24 kg waste.

Each and every respondent from MF and SF were engaged in the activity for 30 and 40 minutes respectively during lean season and 17.0 per cent from MF and 35.0 per cent from SF were carrying out the activity for 30 minutes all through peak season. Whereas, only half number of the respondents i.e. 50.0 per cent from LAL were doing the job for 30 minutes in spite of seasonality.

### **c. Making dung cake**

The participation of the respondents in this activity was varying with the categories of landholdings and season, it was cent percent for LAL and SF in lean season and, 35.0 and 17.0 per cent in peak season, respectively. However, the respondents from both the categories were engaged in the activity for duration of 30 minutes in both seasons. Whereas, respondent from MF only 83.0 per cent were doing the job in lean season for same duration i.e. 30 minutes and did not make dung cake in peak season as during this period dung was used to prepare manure for the farm (Table-6).

**Table-6 Percentage of respondents performing allied activities and time spent in both season**

Activities	Categories of landholding					
	LAL (n=30)		MF (n=30)		SF (n=30)	
	Peak Season	Lean Season	Peak Season	Lean Season	Peak Season	Lean Season
<b>a-Performed daily</b>						
Fodder cutting	100 (60)	100 (90)	100 (60)	100 (90)	83.0 (60)	83.0 (90)
Cleaning animal Shed	50.0* (30)	50.0 (30)	17.0* (30)	100 (40)	35.0* (30)	100 (30)
Making dung cakes	35.0 (30)	100 (120)	0	83.0 (60)	17.0 (60)	100 (90)
Milking	100 (20)	100 (30)	50.0 (30)	50.0 (40)	100 (15)	100* (20)
Grazing of animal	0	100 (120)	0	50.0 (120)	0	0
Feeding animals	50.0* (20)	100 (90)	100 (20)	100 (60)	50.0* (15)	100 (30)
<b>b-Performed weekly</b>						
Fodder collection	0	100*(480)	0	100* (480)	0	50.0* (480)

\*= Jointly with the female member

Value in the parenthesis represents time (in minutes/day) devoted to the activity

#### **d. Milking**

Cent per cent the respondents from LAL and SF and 50.0 per cent of the respondents from MF were carrying out the activity for 30 min apart from landholding categories and season.

#### **e. Grazing animals**

It is mostly performed during rainy season when there is plenty of greenery all around. And this activity was mainly done by children and young females of the family. Cent per cent the respondents from LAL and 50.0 per cent of the females from MF were engaged in it during lean season for 120 minutes (2 hours). None of the respondents from any category were performing this task in peak season.

Whereas, it was observed that respondents from SF categories were neither involved in the activity neither in peak season nor in lean season.

#### **f. Feeding animals**

This activity was performed 3-5 times a day except in rainy season. As animals were taken out for grazing, this activity included giving fodder and water to the animals. The entire number of women from MF was involved in the activity in both seasons, for 30 minutes in peak season and for 60 minutes in lean season. Cent per cent of the women from LAL were doing the job for 60 minutes in lean season whereas; only 50.0 per cent were involved in it for 30 minutes in peak season. All the women from SF were doing the task for 30 minutes in lean season and 15 minutes in peak season as for rest of the time they were assisted by other female members of the family.

#### **g. Fodder collection**

It was an activity which was not performed daily but was done weekly for almost whole day by the respondent either alone or with the help of other family members in lean season. The green fodder was collected when there was plenty of it and was stored for dry season when there would be lack of green fodder. This activity was done by all the respondents of LAL and MF in lean season for 480 minutes (8 hours) and 50.0 per cent of SF respondents for equal duration.

### **4.2.3. Involvement of women in household activities**

Housework (childcare and household chores) and economically extended work (i.e. fetching of water and fuel and making of dung cakes) which is crucial for family's survival, is still exclusively a women's responsibility. Except for fetching fuel, it was the female children who extended a helping hand to their mothers for the above tasks. Women absolutely do not get any help from their men folk for domestic activities and economically extended activities. On the whole, distribution of task responsibility and help received for house work and economically extended work was gender biased and divided along traditional lines, irrespective of women's work status. It may be due to the cultural view that women do housework and men do the outdoor work. The percentage participation of women in household activities is systematically represented in Table-7.

#### **a. Cooking**

Analysis of Table-7 depicts that cent percent respondents from LAL, MF were involved in cooking activity during lean season while only 83.0 per cent from SF were doing cooking in lean season. In remaining families food was prepared by other family member, mainly daughter-in-law of the respondents, but, the time spent on cooking during lean season was same (120 min/day) for all the families irrespective of landholding categories. Whereas, in peak season the percentage of respondents and time spend on cooking decreased to 50.0 percent for LAL and SF while 83.0 per cent of respondents from MF spending relatively less time i.e. 30 min and 40 min respectively on the same activity.

#### **b. Cleaning the house**

The house is a physical setting for family living. Cleaning the house has always been an integrated part of housekeeping and considered as most strenuous activity and demands much energy. Methods of cleaning did not change for centuries and hand made brooms and moppers are used until today. This activity was divided in two parts sweeping and mopping. Majority of household had semi-pucca house.

### **i Sweeping**

Earth floor (kaccha) of the house was sprinkled with water prior to sweeping. Then sweeping was performed by ordinary broom in squatting and bending position by all the respondents. The activity was performed by all the one hundred respondents in lean season and about 60 minutes were spent on it daily. Whereas, only 30 minutes were devoted to the activity in peak season by 17.0 and 35.0 per cent of the respondents from MF and SF respectively, the probable reason for non-participation of LAL in activity during peak season was, they have to work in the farm for eight hours and even more as they work as paid labour.

### **ii Mopping**

It was performed in pucca houses with pucca flooring. So, only 50.0 per cent respondents from SF were performing the activity for 30 min in lean season only because in peak season mopping was done by other female members of the family.

**Table-7 Percentage of respondents performing household activities and time spent in it.**

\* = Jointly with female member

Activities		Household Activities & Time Sent/Day					
		Categories of land holding					
		LAL (n=30)		MF(n=30)		SF(n=30)	
		Peak Season	Lean Season	Peak Season	Lean Season	Peak Season	Lean Season
<b>a- Performed daily (min/day)</b>							
Cooking		50.0* (30)	100 (120)	83.0* (40)	100* (120)	50.0* (30)	83.0 (120)
Cleaning house	Sweeping	30.0 (30)	100 (60)	40.0* (30)	100 (60)	30.0* (30)	75.0 (60)
	Mopping	0	0				
Washing utensils		35.0 (30)	100 (120)	0	83.0 (60)	17.0 (60)	100 (90)
Care of clothes	Washing	0	100 (120)	50.0 (60)	100 (120)	35.0 (35)	100* (60)
	Ironing	0	0	0	0	0	5.0 (10)
	Mending	As needed	As needed	As needed	As needed	As needed	As needed
Personal care		100 (60)	100 (60)	100 (60)	100 (60)	100 (60)	100 (60)
Fetching water		100*(60)	100(120)	100* (60)	100 (120)	50* (60)	100 (120)
Child care activities		100 (60)	100( 60)	100(60)	100 (60)	100* (60)	100* (60)
<b>b-Performed weekly (min/day)</b>							
Cutting and bringing fuel wood		0	100* (480)	0	100* (480)	0	100* (480)
<b>c-Performed monthly (min/day)</b>							
Plastering		0	100* (480)	0	100* (480)	0	100* (480)

\*\*= Jointly with male member

Value in the parenthesis represents time (in minutes/day) devoted to the activity

### c. Washing utensils

Washing utensils included vigorous scrubbing with ash and coarse sand to remove grease and particles from pans and dishes. It was performed 3-5 times a day after every meal and tea. It was performed by the entire cent percent respondents from LAL and SF families daily for respectively 120 and 90 min and by 83.0 per cent of respondents from MF for 60 min in the lean season. Whereas only 35 percent respondents from LAL and 17 percent respondents from SF were doing this activity for 30 and 60 minutes daily respectively during peak season. In rest of the families this work was performed by daughter or daughter-in-law.

### d. Care of clothing

Washing, ironing and mending of clothes were included in care of clothes.

### **i Washing**

It was done by all the respondents from all categories for 120 min in LAL and MF and for 60 minutes by SF with or without the help of other females of the family. Reason for difference in time devoted was, in SF the work was done at home, whereas, LAL and MF took the clothes to river side or to water source, so, duration included time spent in onward and backward journey. During peak season no respondent from LAL family was involved in the activity and 50.0 per cent respondents in MF families for 60 min and 35.0 per cent of respondents in SF for 35 minutes were engaged in it. Clothes were washed by hands either on concrete textured scrubbing surface or at rock on the river side or water source. The rinsing was done at the sink by scooping water and pouring it over the soaped clothes or in bucket at home. Whereas, at the water source the clothes were dunked several times into the current.

### **ii Ironing**

Clothes were ironed using coal filled iron and mostly clothes of male members were ironed. Time contributed to the activity by the respondents was negligible as this activity was mostly performed by young females of the families.

### **iii Mending**

Clothes are mended whenever required whatever season.

## **e. Personal and child care**

Dressing, undressing, bathing, hair combing, walking to an out house to urinate and defecate were included in personal care. And childcare included bathing, changing and dressing children and helping them to eat and more. Bathing was done once/day in summer and on alternate day in winters. Overall analysis of table reveals the fact that personal (60 minutes) and childcare (60 minutes) was performed daily by entire one hundred respondents regardless of landholding categories or seasonality (Table-7).

#### **f. Fetching water**

Review of Table-7 explore that all the respondents whatever categories of landholding, were performing the activity in lean season for 120 minutes and in peak season for 60 minutes except SF, as only 50.0 per cent of the respondents from SF were doing the activity for 60 minutes and help was sought from other females of the families.

#### **g. Cutting and bringing fuel wood**

This work was not done during peak season by any of the respondents from any land holding category whereas in lean season all the respondents were cutting and collecting fuel wood with the help of children or other female members weekly or whenever needed. Whenever this activity was performed 480 minutes/day (8 hours) were spent to it.

#### **h. Floor Plastering**

Floor of kaccha and semi-pucca houses were plastered by all the cent percent respondents monthly, at festivals or whenever required but not in the peak season, with the help of other females of the family. About 480 minutes/ day or a man day was devoted to it despite of landholding categories,

how many days it will take to plaster a house would depend on the area to be plastered and help available in the family.

### **4.3. Occupational health hazards faced by women farmers**

As farm women face various types of health hazard in their day to day work and manage them in their own way, there is a need to assess the extent of health hazards experienced by them as women play important role in production of food grain for us. To fulfill this objective Scale for Assessment of Occupational Health Hazards (SAOHH) developed by Singh and Sinwal, 2005 was used. The scale consists of 30 statements with 15 favourable and 15 unfavourable statements of occupational health hazards. To ensure uniformity in replying a rating scale was used ranging from 'Always' to 'Never'. The respondents were required to give replies within the range of the prescribed rating scale. Reliability and validity was already established using both split-half and test-retest methods.

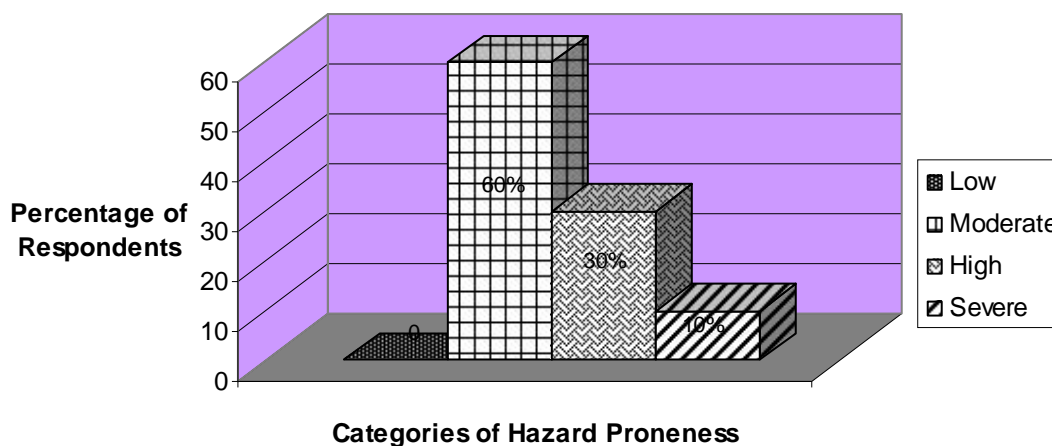
#### **4.3.1. Hazard proneness of the respondents**

Table-8 depicts that a highest percentage of respondents i.e. 60.0 per cent (LAL 50.0%, MF 60.0%, and SF 70.0%) fell in the category of 'moderate' incidence of health hazard while 30.0 per cent (LAL 33.3%, MF 33.3% and SF 23.3%) of total respondents were exposed to 'high' category of hazard proneness and remaining 10.0 per cent were in the severe category of hazard proneness. Significant fact was observed (Figure-6) that no respondent was reported to be in the 'low' category of health hazards.

**Table-8 Percentage distribution of farm women in different categories of hazard proneness:**

S. No.	Categories of hazard proneness	LAL (n=30)	MF (n=30)	SF (n=30)	Total (N=90)
1.	Low incidence of hazards	0	0	0	0
2.	Moderate incidence of hazards	50.0 (15)	60.0 (18)	70.0 (21)	60.0 (54)
3.	High incidence of hazards	33.3 (10)	33.3 (10)	23.3 (7)	30.0 (27)
4.	Severe incidence of hazards	16.7 (5)	6.7 (2)	6.7 (2)	10.0 (9)

**Figure-6 Hazard proneness of the respondents**



Corroborated findings were reported by Sinwal (2003) that most of the rural farm women were in the category of 'High' incidence (74.0 per cent) followed by 'moderate' (34.0%).

#### **4.3.2. Health hazards in selected agricultural activities**

Hazard represents the harm to the health of mankind either physically or mentally due to work, work method or condition, environment, implements or tools used for work, also plants and animals in the surroundings. It is essential to know the agriculture work hazards and their impact on human health so that safe work practices can be adopted timely to preserve them. According to ILO (2006) estimates, from a total of 335,000 fatal workplace accidents worldwide, some 170,000 agricultural workers are killed each year. Mortality rates of the farmers have remained consistently high over the past decade. Farmers suffer from a variety of health hazards. In the present investigation health hazards have been identified for the following selected agricultural activities.

#### **a. Health hazards in land preparation**

The first step for cultivating crop is preparing the field. A well pulverized but compact seedbed is required for good and uniform germination. Land preparation usually comprises of cleaning and leveling of field, manure and fertilizer application, ploughing, harrowing and planking operations. The activity is performed during the months of October-November when the temperature remains between 20-25°C. The survey revealed that the respondents prepared the land either by using a plough driven by bullocks and very few with a tractor. This activity was performed for maximum of two weeks with 5-6 hours spent daily. Respondents reported a number of work hazards during land preparation that are shown in Table -9.

The most prominent physiological hazard as can be seen from Table-9 was fatigue reported by 90.0 per cent of Marginal Farmers (MF) and 73.3 per cent of Landless

Agriculture Labours (LAL) whereas 70.0 per cent of Small Farmers (SF) were affected by this hazard. Posture and bending while performing the activity caused musculoskeletal pain in various body parts and it was reported by 66.7 per cent and 86.7 per cent of LAL and MF respectively whereas approximately 73.3 per cent of SF reported this problem. Such work related musculoskeletal disorders usually occur when there is a mismatch between the physical requirement of the job and the physical capacity of the human body. The data also indicate that approximately 26.7 per cent and 33.3 per cent of LAL and MF respectively reported headache and approximately 16.7 per cent of SF reported the same. Other physiological hazards reported by few of the respondents were sprains or ligament pull and fever due to overexertion.

**Table -9 Percentage Distributions of Respondents showing health hazards in land preparation**

Categories of Hazards	Type of Hazards	Landholding categories			
		LAL (n=30)	MF (n=30)	SF (n=30)	Total (N=90)
Physiological hazards	Body pain	66.7	86.7	73.3	85.0
	Fatigue	73.3	90.0	70.0	83.3
	Headache/ Dizziness	26.7	33.3	16.7	31.7
	Sprains/Ligament pull	6.7	6.7	13.3	10.0
	Fever due to exertion	3.3	6.7	3.3	6.7
	Mean percent	<b>35.3</b>	<b>44.7</b>	<b>35.3</b>	<b>43.3</b>
Mechanical	Injury with tools	20.0	33.3	26.7	31.7
	Ear problem due to noise of tractor	3.3	3.3	3.3	3.3

	Mean percent	13.3	18.3	15.0	17.5
Chemical hazards	Rough skin of hands due to chemicals used	16.7	13.3	33.3	20.0
	Mean percent	16.7	13.3	33.3	20.0
Environmental hazards	Bites/ stings of poisonous organisms	16.7	26.7	26.7	25.0
	Allergy (sneezing & watery nose)	16.7	23.3	10.0	25.0
	Cuts & thorny puncture in hands & feet	50.0	70.0	40.0	68.3
	Mean percent	27.8	40.0	25.5	39.5

Use of tools and equipment for work has led to mechanical hazard of injury. It was reported by 20.0-33.3 per cent in all the categories. Another hazard reported by very few (3.3%) of total respondents from all the three categories was noise induced hearing loss due to use of tractors for preparing land. Use of chemical fertilizers, pesticides or insecticides during land preparation affected the skin of the palms and it usually becomes rough. About 16.7, 13.3 and 33.3 per cent of respondents from respectively LAL, MF and SF complained roughness of hand skin.

Environment where the work is carried out also poses certain problems to the worker. In case of land preparation the respondents experienced cuts and thorny puncture and it was reported by 50.0 per cent of LAL and 70.0 per cent of MF and 40.0 per cent of respondents from SF categories. Allergy from dust, which caused sneezing and watering of nose, was reported by 16.7, 23.3 and 10.0 percent of the respondents from LAL, MF and SF respectively. Bites and

stings from poisonous organisms were also reported by 25.0 per cent of total respondents.

It is clear from the data that fatigue and body pain and cuts and thorny puncture in hands and feet ranked first, second and third respectively with majority of respondents confronting these hazards while preparing fields for any type of crops. Next to these approximately 20-30 per cent of the farm workers had the problem of headache and dizziness during land preparation and confronted the hazards of injury and poisonous organism bites. It can also be concluded from the data that farm workers are exposed to all types of hazards (Figure-7).

#### **b. Health hazards in sowing**

The manual work during sowing seeds, especially material handling, may involve considerable physical loads on the part of the worker. While sowing wheat the temperature ranges between 20-25<sup>o</sup> C. The survey revealed that sowing of wheat was done by few respondents with seed-drills that were tractor or bullock-drawn. In most of the places, seeds were sown by Kera/ pora method in which a person pour seeds with hand in furrows behind the plough or in the iron tubes attached for this purpose. The man does the ploughing and the women walked behind the plough putting seeds and fertilizer. The health hazards during sowing are shown in Table-10 and Figure-8.

The operation of sowing is an arduous task requiring an immense amount of labour. Table-10 confirms this as the data depicts that approximately 90.0 per cent of LAL, cent per cent of the respondents from MF and approximately 93.3 per cent of the SF reported physiological hazards such as fatigue and pain, sprains or ligament pull while

performing this task as the job require repetitive motions putting strain on the muscles. The worker repeatedly performs lifting, pulling, twisting and bending motions that exert force on the musculoskeletal system of the body and thereby leading to fatigue and pain.

**Table -10 Percentage Distributions of Respondents showing Health hazards in Sowing**

Categories of Hazards	Type of Hazards	Landholding Categories			Total (N=90)
		LAL (n=30)	MF (n=30)	SF (n=30)	
Physiological hazards	Body pain	90.0	100	93.3	94.4
	Fatigue	93.3	100	90.0	94.4
	Headache/ Dizziness	66.7	90.0	66.7	74.4
	Mental stress	20.0	26.7	33.3	26.7
	Fever due to exertion	6.7	13.3	20.0	13.3
	Mean percent	<b>55.3</b>	<b>66.0</b>	<b>60.7</b>	<b>60.6</b>
Mechanical hazards	Injury with equipment	63.3	70.0	76.7	70.0
	Accidents with tractor	33.3	20.0	6.7	20.0
	Fracture due to falling	16.7	10.0	3.3	10.0
	Ear problem due to noise	6.7	3.3	3.3	4.4
	Mean percent	<b>30.0</b>	<b>25.8</b>	<b>22.5</b>	<b>26.1</b>
Chemical	Rough skin of palms handling of	33.3	26.7	36.7	32.2

	<b>fertilizer</b>				
	<b>Mean percent</b>	<b>33.3</b>	<b>26.7</b>	<b>36.7</b>	<b>32.2</b>
<b>Environmental hazards</b>	<b>Eye problems from dust in air</b>	16.7	23.3	10.0	16.7
	<b>Allergy from dust</b>	16.7	23.3	10.0	16.7
	<b>Cold &amp; cough due to low temperatures</b>	13.3	20.0	16.7	16.7
	<b>Mean percent</b>	<b>15.6</b>	<b>22.2</b>	<b>12.2</b>	<b>16.7</b>

Headache and dizziness was reported by 66.7 per cent of LAL and SF whereas 90.0 per cent of respondent from MF reported this hazard. The farmwomen from MF category were most susceptible to this, as they had to continuously walk behind the plough for putting seeds in the furrows. Mental stress was reported by 20.0 per cent and 33.3 per cent of LAL and SF respectively and in MF this problem was reported by 26.7 per cent of the respondents which was comparatively higher than in the two categories respectively. Few of the respondents also reported fever.

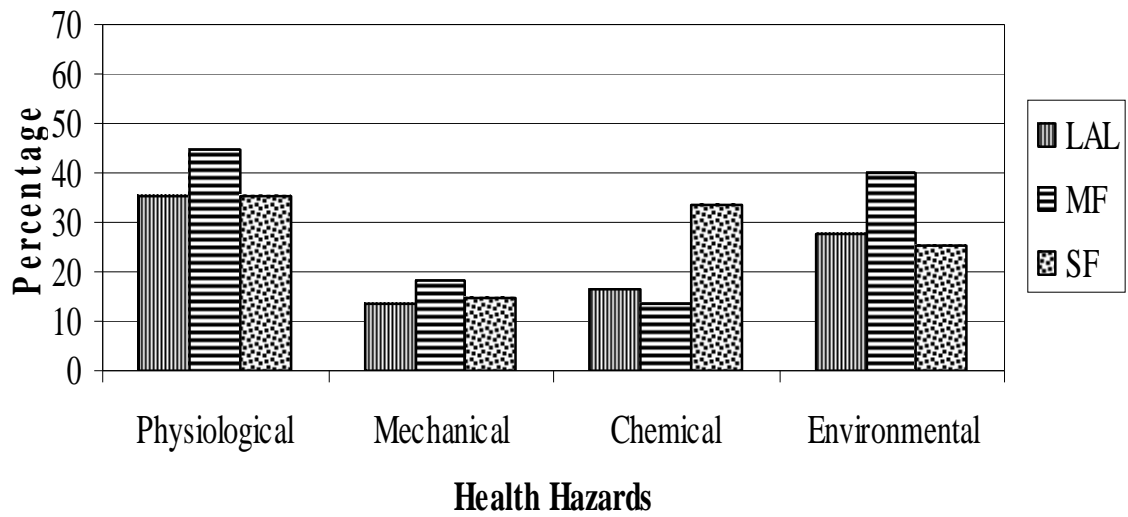
Mechanical hazards occur due to tools and implements used for this operation and repetitive motions of the body while working with them are responsible for wear and tear of the body that produces several injuries. About 63.3 per cent of LAL, 70.0 per cent of respondents from MF and 76.7 per cent of SF were exposed to injury hazard.

Similar findings were given by Becker (2001) in his study. He found that the major agents of injury were working surfaces, heavy objects and motor vehicles. These three

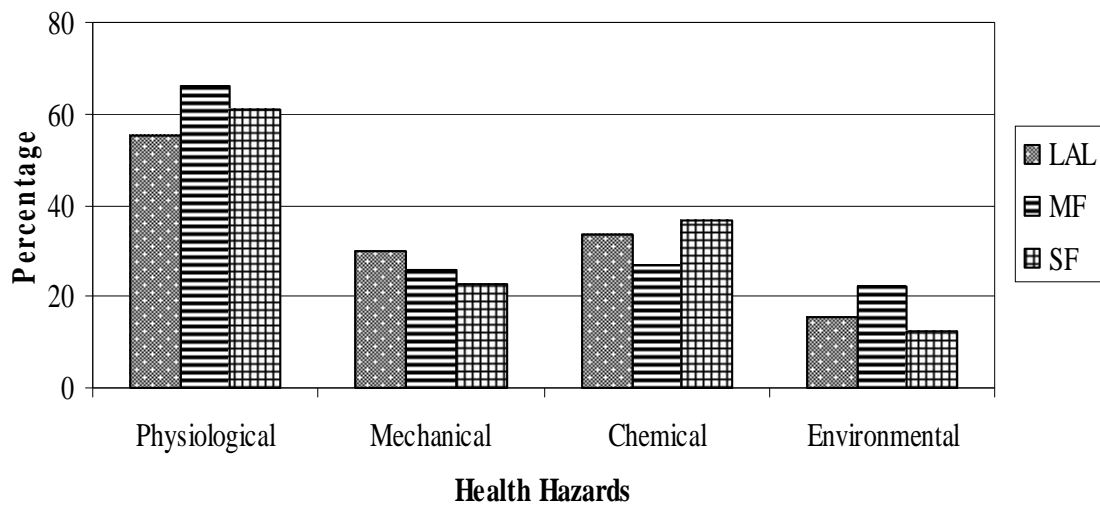
agents cause over 50.0 per cent of all serious injuries. Two major types of accidents were overexertion (lifting, pushing and pulling) and falls: this account for over 50.0 per cent of all serious injuries. The result is that nearly 50.0 per cent of all injuries are sprains and strains to the back and the major body joints: the shoulder, elbow and wrist, the hip, knee and ankle. Accidents while operation of farm machines was reported by 33.3 per cent of respondents from LAL, 20.0 per cent of respondents from MF and the same was reported by few i.e. 6.7 per cent of the respondents belonging to SF category of landholding. Similarly, fracture and ear problem was reported by more number of wheat growers as compared to the respondents growing vegetables.

Rough and chapped skin of palm and feet were the chemical hazards reported by approximately one third of total from LAL and approximately one-fourth of the MF reported this problem. The data in Table-10 also portrays that approximately 16.7 per cent of respondent, 23.3 and 10.0 per cent of respondents from LAL, MF and SF reported allergy from dust.

### **Figure-7 Health hazards in land preparation**



**Figure-8 Health hazards in sowing**



Thus it can be concluded from Figure-8 that, while performing the activity of sowing they mostly face physiological health hazards. Both pain in body and fatigue were the major hazards acclaimed by almost all the

respondents and ranked on the top. Headache and dizziness ranked second and injury due to the tools and equipment ranked third and can be said as key health hazards of sowing.

### **c. Health hazards in weeding**

Weeding is one single operation which can increase crop yields without much additional investment because efficient weeding will save moisture and crop nutrients. The removal of weeds from the growing crop facilitates easy harvesting and gives high quality produce without admixture with weed seeds. The survey revealed that the respondents usually performed this operation by hand or using a hand tool "khurpi" or hand hoe. The posture adopted during work was back bending for several hours in a day. Thus, this task is backbreaking, time consuming and costly. The health hazards during weeding operation are reported in Table-11.

It is clear from the data in Table-11 that physiological hazard such as body pain and fatigue were the major hazards confronted by the respondents. Body pain was reported by 80.0, 86.7 and 90 per cent of LAL, MF and SF respectively. As the task of weeding is very tiresome and requires continuous back bending, fatigue was reported by 70.0 per cent of LAL, 86.7 per cent of MF and 73.3 per cent from SF category respectively.

Some or other kind of infection from water, soil, injury or bacteria/ viruses was reported by 33.3 per cent LAL, 50 percent of MF and 23.3 per cent of SF reported this hazard. Headache/dizziness was confronted by 13.3 per cent and fever by 20 per cent of respondents from LAL whereas 33.3

per cent of MF had these problems About 20.0 per cent respondents from SF reported headache /dizziness and approximately 16.7 per cent reported fever.

Injury with the weeding tool was one of the major mechanical hazards reported by 83.3 per cent of respondents in both the LAL and SF categories of land holding whereas more percentage of females i.e. 90.0 per cent MF reported this hazard.

**Table-11 Percentage Distributions of Respondents  
showing Health Hazards in Weeding**

Categories of Hazards	Type of Hazards	Landholding Categories			Total (N=90)
		LAL (n=30)	MF (n=30)	SF (n=30)	
Physiological hazards	Body pain	80.0	86.7	90.0	85.5
	Fatigue	70.0	86.7	73.3	76.7
	Headache/ Dizziness	13.3	33.3	20.0	22.2
	Infection	33.3	50.0	23.3	35.5
	Fever due to overexertion	20.0	33.3	16.7	23.3
	Mean percent	<b>43.3</b>	<b>58.0</b>	<b>44.6</b>	<b>48.64</b>
Mechanical	Injury with tool	83.3	90.0	83.3	85.5
	Mean percent	<b>83.3</b>	<b>90.0</b>	<b>83.3</b>	<b>85.5</b>
Chemical hazards	Eye Problems due to chemical spray in field	6.7	13.3	26.7	15.5
	Mean percent	<b>6.7</b>	<b>13.3</b>	<b>26.7</b>	<b>15.5</b>
Environmental hazards	Bites & stings	23.3	53.3	23.3	33.3
	Allergy of skin	23.3	40.0	16.7	26.7
	Cold & cough	3.3	6.7	3.3	4.4
	Mean percent	<b>16.6</b>	<b>33.3</b>	<b>14.4</b>	<b>21.4</b>

The chemical hazard reported was eye problem, which was confronted by less number of respondents; it is sometimes

caused when there is accidental eye-hand contact. Approximately 26.7 per cent of SF indicated this problem whereas only 6.7 per cent LAL and 13.3 per cent SF reported this hazard (Table-11).

Environmental hazards such as bites and stings of poisonous organism were confronted by 23.3 per cent of LAL and SF and 53.3 per cent of respondents from MF category reported this hazard. Allergies of skin were reported by 23.3 per cent of LAL, approximately 40.0 per cent of respondents from MF and 16.7 per cent respondents of SF landholding category.

Thus, conclusion from Figure-9 can be drawn that respondents mostly face mechanical hazards like injuries. Tools and equipment used for work may be held responsible for injuries during weeding.

#### **d. Health hazards in harvesting**

Crop harvesting is carried out under a wide variety of conditions, over various types of terrain, utilizing machines from simple to complex that must handle a diversity of crops; it involves considerable physical effort from the farmer. The crop of wheat is harvested when the grains harden and the straw becomes dry and brittle. As a rule, harvesting lasts from 25 to 40 days in the months of March-April when the environment becomes quite hot and the temperature is about 35-40°C. Most of the respondents used sickle for cutting wheat. The hazards faced by the respondents during harvesting are reported in Table-12.

The primary hazards associated with the more labour-intensive harvesting practices have changed little with time and are overshadowed by the increased risks associated with mechanization. Long hours of exposure to the elements, the physical demands resulting from lifting and moving heavy loads, repetitive motion and awkward or stooped posture, along with natural hazards such as poisonous insects and snakes, have historically taken, and continue to take, a significant toll. Physical drudgery is associated with manual harvesting, as it is quite uncomfortable and exhausting task and is completed frequently by large number of children and women.

The data in Table-12 demonstrate that cent per cent the respondents from LAL and MF and approximately 80.0 per cent of SF reported musculoskeletal problems such as pain, sprains etc. as the task is very labour-intensive and requires continuous effort from the worker. Fatigue was another hazard reported by 100 percent of LAL and MF whereas 60.0 per cent of SF reported fatigue while harvesting. Skin problems such as irritation, itching and rashes on skin were reported by 33.3, 43.3, 70.0 per cent of respondents from LAL, MF and SF harvesting respectively reported skin problem due to contact of skin with plant material. Harvesting bring the hazard of headache for 30.0 per cent of respondents of LAL, 50.0 per cent of MF and 20.0 per cent of respondents from SF category confronted this problem.

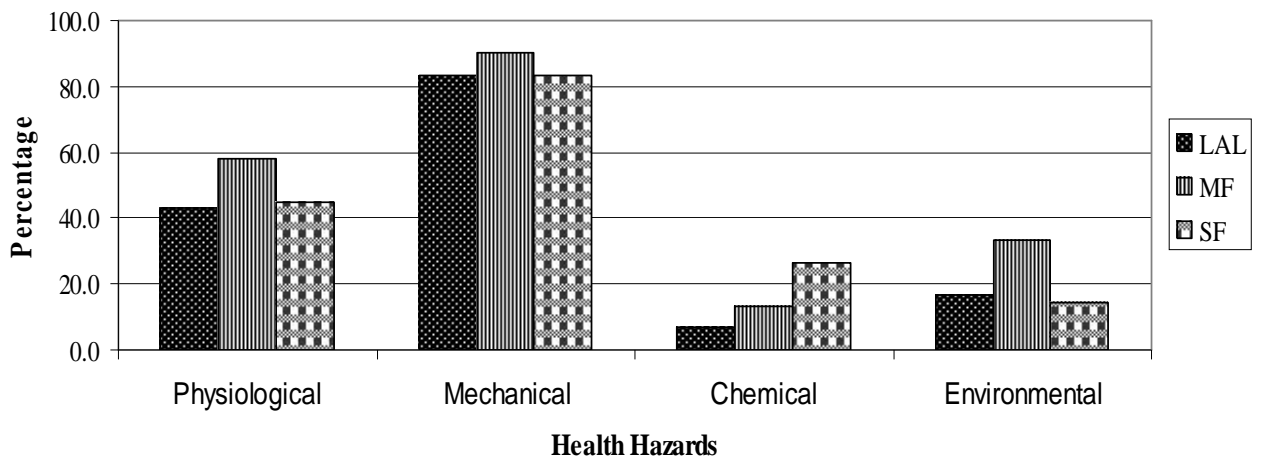
**Table -12 Percentage Distributions of Respondents showing Health Hazards in Harvesting**

Categories of Hazards	Type of Hazards	Landholding Categories			Total (N=90)
		LAL (n=30)	MF (n=30)	SF (n=30)	
Physiological hazards	Body pain	100	100	80.0	93.3
	Fatigue	100	100	60.0	86.7
	Skin problems	33.3	43.3	70.0	48.8
	Headache/ Dizziness	30.0	50.0	20.0	33.3

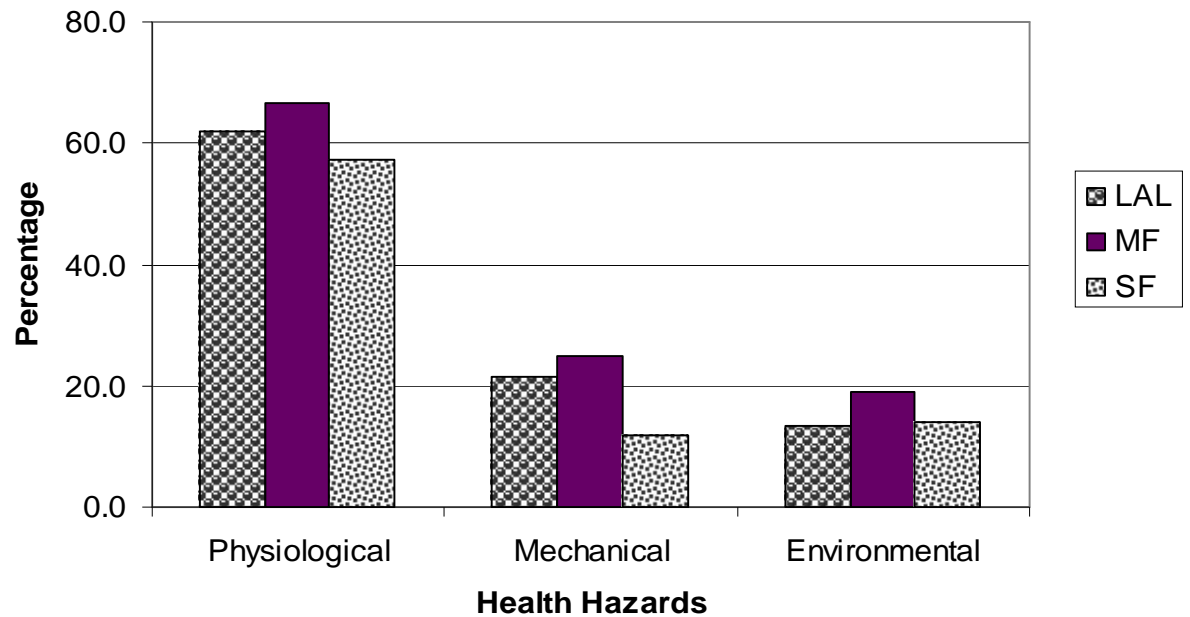
	<b>Mental Stress</b>	46.7	40.0	56.7	47.8
	<b>Mean percent</b>	<b>62.0</b>	<b>66.7</b>	<b>57.3</b>	<b>62.0</b>
<b>Mechanica I hazards</b>	<b>Accidents</b>	20.0	16.7	6.7	14.4
	<b>Injury</b>	23.3	33.3	16.7	24.4
	<b>Mean percent</b>	<b>21.6</b>	<b>25</b>	<b>11.7</b>	<b>19.4</b>
<b>Environmental hazards</b>	<b>Respiratory problems</b>	20.0	33.3	16.7	23.3
	<b>Heat Stroke</b>	10.0	16.7	16.7	14.4
	<b>Bites &amp; stings</b>	16.7	20	16.7	17.8
	<b>Eye problems</b>	6.7	6.7	6.7	6.7
	<b>Mean percent</b>	<b>13.3</b>	<b>19.1</b>	<b>14.2</b>	<b>15.5</b>

During harvesting 46.7 per cent LAL, and 40.0 per cent of MF and 56.7 per cent of SF were mentally stressed. The stress factors attributed were workload, timely harvesting of

**Figure-9 Health hazards in weeding**



**Figure-10 Health hazards in harvesting**



the crop, quality and quantity of produce, marketing of the farm produce and getting proper monetary value. Flachs (2002) in his study also concluded that farming has many ongoing situations that cause stress. The most common stressors include finances, daily hassles, and lack of control over weather, work overload, and conflict in relationship issues. When faced with a stressful situation one may experience physical symptoms, such as headache or stomach problems.

With increased mechanization of the farm, accidents and injuries involving farm equipment's are common, and the most injured body parts are the extremities, such as fingers and limbs (Ogilvie, 1999). During harvesting 20.0 per cent and 23.3 per cent of respondents from LAL and 16.7 per cent and 33.3 per cent of respondents from MF reported accidents and injury respectively. These hazards were due to the tools and farm machines used. Some accidents also involved tractor and transportation vehicle.

Among SF only 6.7 per cent reported accidents and approximately 16.7 per cent of them reported injury with the tool used for harvesting.

Grain dust and climatic conditions can be environmental hazards during harvesting wheat. These can pose serious long-term health risks to the persons involved in harvesting. The grain dust and pollens suspended in air creates respiratory problems and were faced by 20.0 per cent of LAL, 33.3 per cent of SF and only 16.7 percent of reported respiratory problems. Bites and stings from poisonous organism were reported by approximately 16.7 per cent of respondents from both LAL and MF categories and by 20.0 per cent of SF category. Heat stroke was observed by 10 per cent of LAL and approximately 16.7 per cent of MF and SF confronted this hazard. Nearly 6.7 per cent of the total respondents also had eye problem due to particles of hay or plants which may cause eye injury.

Thus, to summarize that Figure-10 the major hazards in harvesting it can be said that body pain ranked first, followed by fatigue and skin problem confronted by maximum number of respondents . And lowest was environmental hazards.

## **4.4. Nutritional Profile of the respondents**

Nutritional profile of the respondents was assessed in terms:

### **4.4.1. Anthropometry of the Respondents**

Adult anthropometry is frequently used for assessing state of health and nutritional status. Growth, as represented by height and weight for age is believed as to be one of the most definitive indicators of nutritional status. Energy intake reflects the weight of an individual. Deficient intake of energy

over a period of time results in weight loss. When the deficit continues for a longer period, the dietary protein though insufficient will be driven as a source of energy and as a result growth will be affected. These deficits in growth are readily indicated by decreased values of anthropometric measurements (Singhal, 1992).

### a. Height as the percent of the standard

The classification of height as the percent of standard is given in Table-13 and Figure-11 which depicts that nearly half (48.9%) of the total respondents were either dwarf or short in height, less than half (44.4%) of the respondents from all the categories were normal in height and only 6.7 per cent were giant. Approximately one third of the respondents (LAL 36.7 %, MF 33.3% and SF 43.3 %) were short in height as compared to the standards.

**Table-13 Percentage distribution of respondents on the basis of height as the percent of standard.**

Height as % of standard	Interpretation	Landholding Categories			Total N=90
		LAL (n=30)	MF (n=30)	SF (n=30)	
<80	<b>Dwarf</b>	13.3 (4)	10.0 (3)	10.0 (3)	11.1 (10)
80-93	<b>Short</b>	36.7 (11)	33.3(10)	43.3 (13)	37.8 (34)
93-105	<b>Normal</b>	40.0 (12)	50.0(15)	43.3 (13)	44.4 (40)
>105	<b>Giant</b>	10.0 (3)	6.7 (2)	3.3 (1)	6.7 (6)

Figure in parenthesis show no. of respondents

### b. Weight as the percent of the standard

The weight was calculated as the percent of standard and classified as suggested by McLaren (1976) and given in Table-14 which represents that only one fourth (25.6%) of the total respondents were normal in weight and one forth were over nourished whereas, majority (48.9%) were more or less malnourished (Table-14 and Figure-12).

**Table-14 Percentage distribution of respondents on the basis of weight as the percent of standard.**

Weight as % of Standard	Interpretation	Landholding Categories			Total N=90
		LAL (n=30)	MF (n=30)	SF (n=30)	
<60	Severe malnutrition	3.3 (1)	10 (3)	10 (3)	7.8 (7)
60-80	Moderate malnutrition	26.7 (8)	23.3 (7)	20 (6)	23.3 (21)
80-90	Mild malnutrition	16.7 (5)	20 (6)	16.7 (5)	17.8 (16)
90-110	Normal	26.7 (8)	23.3 (7)	26.7 (8)	25.6 (23)
110-120	Over nutrition	13.3 (4)	13.3 (4)	16.7 (5)	14.4 (13)
>120	Obese	13.3 (4)	10 (3)	10 (3)	11.1 (10)

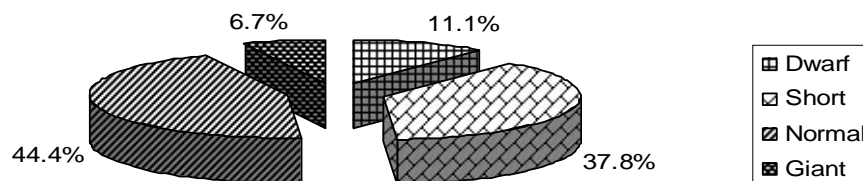
Figure in parenthesis depicts no. of respondents

### c. Body Mass Index of the respondents

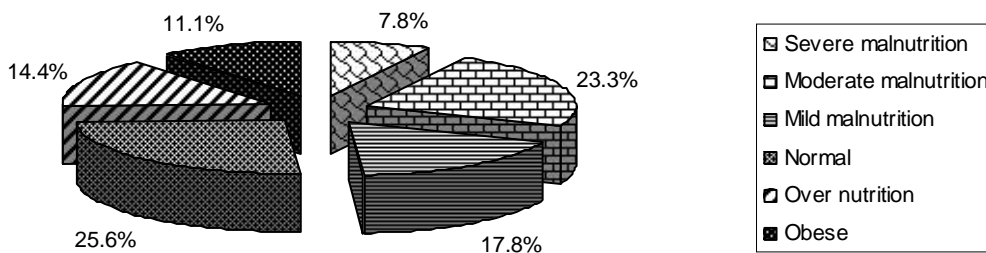
One of the specific measures of nutritional status is Body Mass Index (BMI), which is an indicator of thinness or fatness and is defined as weight divided by the square of height. It helps us to know the physical fitness and nutritional status of the person. The weight of the person should be in accordance to the height of the person. The main purpose of studying BMI is to know relation of an individual's health to hazard proneness.

It is presumed that a person will have low BMI if his nutritional status is low. Lower the BMI lesser the resistance of the body to fight against diseases. The nutritional deficit person will soon get fatigued also because the muscles of such person are not strong enough to bear the stress and strain. The index weight/height which has been known as BMI, was found useful for the assessment of the current or short duration form of malnutrition among infants, preschool children and adults (Rao and Singh, 1970; Rao and Rao, 1975; Raman et al., 1989, 1987; Subash and Chuttani, 1979).

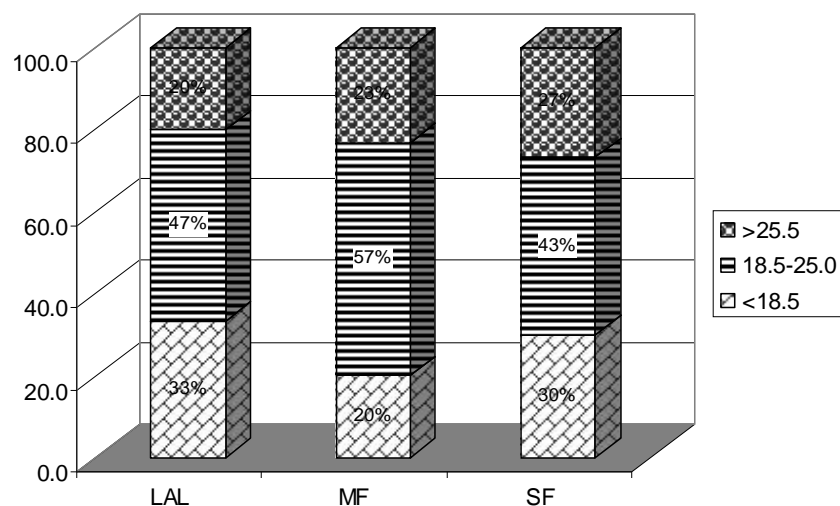
**Figure.11 Respondent's height as % of the standard**



**Figure.12 Respondent's weight as % of the standard**



**Figure.13 BMI of the respondents**



It was observed from Table-15 that less than half (46.7% in LAL and 43.3% SF) of the respondents fell in normal grade of BMI (Body Mass Index), while 56.7 per cent of MF had normal BMI, and ample no of the respondents were either chronic energy deficient (33.3% in LAL, 20.0% in MF and 30.0% in SF) or obese (20.0% in LAL, 23.3% in MF and 26.7% in SF), which clearly indicates some kind of nutritional imbalance.

**Table-15 Body Mass Index of women farmers:**

Presumptive diagnosis	BMI scores	Landholding Categories			Total N=90
		LAL (n=30)	MF (n=30)	SF (n=30)	
<b>CED</b>	<b>&lt;18.5</b>	33.3 (10)	20.0 (6)	30.0 (9)	27.8 (25)
<b>Normal</b>	<b>18.5-25.0</b>	46.7 (14)	56.7 (17)	43.3 (13)	48.9 (44)
<b>Obese</b>	<b>&gt;25.5</b>	20.0 (6)	23.3 (7)	26.7 (8)	23.3 (21)

Figure in parenthesis shows no. of the respondents

The overall data (Figure-13) also indicate similar inference i.e, nearly half of the respondents were in normal grade while rest half were not having good nutritional status as per BMI, they either fall in CED or Obese grade of BMI.

The data was analyzed to understand association of BMI with incidence of hazards proneness of the respondents. A correlation was calculated to determine the effect of Body Mass Index on hazard proneness. The values of correlation coefficient are presented in the Table-16.

**Table-16 Correlation Coefficient of Body Mass Index and Hazard proneness.**

<b>Presumptive diagnosis of BMI</b>	<b>BMI class</b>	<b>LAL (n=30)</b>	<b>MF (n=30)</b>	<b>SF (n=30)</b>	<b>Total (N=90)</b>
<b>CED</b>	<b>&lt;18.5</b>	- 0.932**	- 0.311**	- 0.750**	- 0.980**
<b>Normal</b>	<b>18.5-25.0</b>	-0.544	- 0.840**	- 0.704**	-0.390
<b>Obese</b>	<b>&gt;25.5</b>	- 0.745**	-0.319	-0.618*	-0.444

\*\*Significant at 0.01 level, \*Significant at 0.05 level

It can be predicted from the values in the Table-16 that BMI and hazard proneness are negatively correlated which means that as BMI decreases the incidence of hazard increases. Respondents having low BMI may become hazard prone due to their decreased work capacity and lower energy level. The nutritional deficit person will soon get fatigued also because the muscles of such person are not strong enough to bear the stress and strain. It is known fact that women could work and contribute significantly to the economy when they are healthy as unhealthy women cannot make any valid contribution. But various studies have indicated that there are numerous debilitating health

hazards that affect women's productively and reduce efficiency at work.

On the basis of BMI a sub sample of 18 subjects was selected i.e. six women from each landholding category representing the different grades of BMI i.e. obese, normal and CED.

#### **4.4.2. Dietary Adequacy**

##### **a. Dietary Pattern**

The general dietary pattern of farmwomen revealed that three meal pattern was followed by most of the women. Almost all the women were taking tea with or without chapatti (roti). Some of them were taking milk instead of tea. The major meal (lunch, dinner) included mainly chapatti made of maize flour with dhal or seasonal vegetables or buttermilk or milk or kadhi (a buttermilk and Bengal gram flour preparation) or onion to eat chapatti. In the evening all the farmwomen used to drink tea after they finished their work in the farm

##### **b. Food Intake**

The nutritional status of any individual is directly affected by his or her food intake. Man needs a wide range of nutrients to lead a healthy and active life and these are derived through the diet she /he consumes daily. The component of diet should be chosen judiciously so that it provides all the nutrients in adequate amount and proper proportions (ICMR, 1990).

In the present study 18 farmwomen, selected on the basis of BMI, were studied for their daily food intake by 24 hours recall method. The food and nutrient intake was compared with balance diet suggested by Indian Council of Medical Research (NIN, 1998). The food intake was calculated for three days. Intake was almost same therefore; mean was calculated and expressed as percentage of balance diet suggested for Heavy working adult women (NIN, 1998). The results on food intake are being discussed below in Table 17a and 17b:

**i Cereals:** Cereals are the part and parcel of Indian diet and they provide energy and several other nutrients at very low cost. These are cheapest and widely available sources of nutrient particularly in developing countries like India. All the subjects in the study were consuming cereals. The mean cereal intake was 462, 465 and 467 g/day in LAL, MF and SF respectively during lean season and it was 96.0 per cent in LAL and 97.0, 98.0 per cent of the balance diet (480 grams) in MF and SF respectively during lean season (Table-17b). In peak season its consumption was (LAL-482, MF-488 and SF-479 grams), which was 100, 102 and 100 per cent (Table 17b) of the balance diet. Cereal intake was slightly higher in peak season than in lean season but still the difference was non-significant (Table-17a). The main cereal consumed was maize in the form of flour in the preparation of chapatti, rab etc. Rice and wheat were also consumed but occasionally or seasonally.

Kumawat (1988) studied food consumption status of female workers of Udaipur district and reported that 100 per cent of workers were consuming cereals daily and Goswami (1984) studied the food consumption pattern in rural areas of Assam and found that per capita expenditure on food was Rs 3.59 and out of this Rs 1.71 was spent on cereals alone revealing that cereals was the main food in their daily diet.

**ii Pulses:** Pulses are main source of protein in Indian diets. Subject consume extremely low amount of pulses than the amount recommended in balance diet (Table-17a). Consumption of pulse was only 63.0, 65.0 and 67.0 per cent of balance diet (90 grams) in lean season and 70.0, 65.0 and 70.0 per cent of the balance diet during peak season in LAL, MF and SF respectively and was significantly lower. Difference in consumption of pulses was non-significant irrespective of landholding categories and season (Table-17b). It may be due to low production and high prices of the pulses. Sadasivan et al. (1980) also reported low consumption of the pulses in comparison to RDA in villages of Tamil Nadu.

**iii Green Leafy Vegetables:** These are the rich source of calcium, iron, Beta-carotene, vitamin C, riboflavin, and folic acid. Out of total respondents only 22.0 percent were consuming green leafy vegetable. Consumption was 55.0, 67.0, and 71.0 per cent of balance diet (100grams) during lean season and 58.0, 71.0 and 73.0 per cent of the balance diet (100 grams) in peak season respectively in LAL, MF and SF. Mean intake of green leafy vegetable

was lower than the balance diet (Table-17b). But Table-17a reveals the fact that the difference in intake during lean and peak season was non-significant regardless of landholding categories. Poor consumption may be due to unawareness and food habits of the farmwomen.

Table-17a Mean±SD consumption of various food groups by farm women from different landholding categories in lean and peak season.

Food Groups	Categories of landholdings (N=18)								
	LAL (n=6)			MF (n=6)			SF (n=6)		
	Lean season	Peak season	t-values	Lean season	Peak season	t-values	Lean season	Peak season	t-values
<b>Cereals</b>	462±18	482±38	0.053 NS	465± 12	488± 31	0.09 NS	467± 13.25	479± 43	0.074 NS
<b>Pulses</b>	57± 5.15	63± 11	0.075 NS	59± 7.48	59±7.4 8	0.026 NS	61± 7.9	63± 9.98	0.044N S
<b>Green leafy vegetables</b>	55±10	58±8.10	0.484 NS	67± 30	71± 4.8	0.24 NS	71± 4	73± 14	0.33 NS
<b>Roots and Tubers</b>	199± 23	202±32	0.311 NS	229± 23	235± 29	0.38 NS	224±21	230± 24	0.123 NS
<b>Other Vegetables</b>	51± 6.69	55± 7.27	0.09 NS	50± 6.24	57± 11	0.29 NS	52± 5.3	53± 9.6	0.284 NS
<b>Fruits</b>	0	0	0	52± 5	56± 9	0.78	54± 3.86	55± 10	0.388

						NS			NS
<b>Milk and milk products</b>	374± 70	358± 72	0.68 NS	376± 67	362± 63	0.85 NS	409± 54	390± 43	0.020 NS
<b>Sugar and jaggery</b>	26± 2.73	30± 3.55	0.54 NS	25± 5	25± 2.47	0.44 NS	26± 2.87	22± 6.71	0.059 NS
<b>Fats and oils(visible)</b>	13.7±3. 18	13±2.67	0.212 NS	14.15±2. 66	15.15± 2.6	0.216 NS	13± 3.01	15.9± 5.16	0.059 NS

NS Non-Significant

**Table-17b Mean±SD Percent of Balance diet taken by the respondents in lean and peak agriculture season**

\* Balance diet Suggested by NIN (1998)

Food Groups	Balance diet* (gms/day)	LAL (n=6)		MF (n=6)		SF (n=6)	
		Lean season	Peak season	Lean season	Peak season	Lean season	Peak season
Cereals	480	96±3.75	100±3	97±5	102±4	98±4	100±15
Pulses	90	63±3	70±4	65±6	65±3	67±2	70±5
Green leafy vegetables	100	55±2	58±6	67±6	71±4	71±5	73±4
Roots and Tubers	200	99.5±16	100±7	114±23	117±8	112±22	115±6
Other Vegetables	100	51±8	55±5	50±3	57±6	52±3	53±5
Fruits	100	0	0	52±7	56±6	54±5	55±4
Milk & milk products	300	124±16	120±7	125±16	121±7	135±16	130±12
Sugar and jaggery	45	57±3	66±5	56±9	55±12	104±11	50±9
Fats and oils(visible)	40	33±5	33±4	32±2	37.5±3	33±4	40±6

**iv Roots and Tubers:** Roots and tubers are the richest source of energy among fruits and vegetables. In the present study all the subjects were consuming roots and tubers in daily diet. Examination of Table-17a depicts that, in LAL its consumption was 199 grams during lean season which was 99.5 per cent (Table 17b) of the

balanced diet (200 grams/day). Its consumption was higher than LAL in MF (114.0%) and SF (112.0%) during lean agriculture season. Whereas, its consumption was 100.4, 117.0 and 115.0 per cent of balance diet in LAL, MF and SF, respectively in peak season. Whereas, Table-17a shows that the consumption of roots and tuber was almost same in both season irrespective of landholding categories. The major root and tuber consumed by them were potato and onion. Potato is one of the widely consumed tubers all over the world from poorest to poor and rich people.

- v **Other Vegetable:** Vegetables which do not come under green leafy vegetables and roots and tubers come under this category. The commonly used vegetables are cluster beans, bottle guard, cucumber, ladies finger. Ninety five per cent of the farm women from LAL, MF and SF included these vegetables in their daily diet but mean intake was nearly half (LAL 51.0%, MF 50.0% and SF 52.0%) of the recommended balance diet (100 grams/day) during lean season, and in peak season its consumption was little higher (LAL 55.0%, MF 57.0% and SF 53.0%) than lean season but still lower than balance diet and the difference in intake was non-significant (Table-17a and 17b). Vegetable which was available and cheap was purchased irrespective of leafy, roots or other vegetable. It was prepared as curry to eat chapatti.

Pushpamma et al (1984) conducted a study on the consumption pattern of vegetable and fruits by rural families in Andhra Pradesh and reported that the amount

of vegetable in daily diet was very low, as 90.0 per cent of the families do not included roots, leafy vegetable in their diet. Leafy vegetable was consumed daily by only 50.0 per cent of the families, including a very low intake of vegetable and fruits. Chaturvedi (1998) also reported lower consumption of roots and tubers and green leafy vegetable among women of command and non-command areas of Kota.

**vi Fruits:** Fruits are generally good sources of vit C in addition they also provide  $\beta$ -carotene (papaya), energy (banana) and iron (dried fruits). Among fruits mango, banana and tomato were consumed by most of the subjects. Out of 90 subjects only 20.0 and 33.0 per cent from MF and SF consumed respectively 52.0 and 54.0 per cent of the balanced diet in lean season, and 56.0 per cent (MF) and 55.0 per cent (SF) in peak season (Table-17b). Consumption was considerably lower than the balanced diet. Reason for lower intake appears to be due to their higher price and low purchasing power of the respondents. Sankhla et al. (1991) and Nagi and Kaur (1995) reported a low intake of fruits by adult male and female subjects.

**vii Milk and milk products:** Milk is not only a good source of protein, but it also provides calcium and riboflavin. The overview of Table-17a shows that, mean intake of milk by LAL and MF was approximately the same (374 and 376 g/day)

and by SF it was highest (409 g/day) which was 135.0 per cent of the balanced diet. The consumption in peak season was approximately equal (120.0, 121.0 and 130.0 per cent) in all the three categories of land holdings (Table-17b). Intake was found high in the present study in comparison to balanced diet as milk was consumed by all farm women in preparation of tea or plain milk or butter milk. Butter milk was also profoundly consumed in the preparation of kadhi and rab.

**viii Sugar and Jaggary:** These are sweetening agents consumed by almost all the people in varying amounts. They are added to the beverages and other foods to increase their palatability. These essentially supply energy but, Jaggery also contains some iron. It was consumed by all the subjects in tea and milk. The mean intake of sugar in LAL, MF and SF was almost equal i.e. 26, 25 and 26 g/day which is about 57.0, 56.0 and 57.0 per cent of the balance diet (45 grams/day) in lean season. In peak season (Table-17a) the intake was approximately same (LAL 30, MF 25 and SF 22 grams/day) as lean. The intake was lower than balance diet; reason primarily appears to be due to low consumption of sweets and other beverages by farm women due to low purchasing capacity.

Sankhla et al. (1991) and Nagi and Kaur (1995) also reported low intake of sugar and Jaggary by their respective study subjects. Contrary to the present findings, adequate intake of sugar and jaggary was

reported by Sidhu and Singh (1987) while carrying their study on farm workers in Ludhiana district.

**ix Fats and Oils:** The visible fats commonly used in India are hydrogenated fats, butter, oils and ghee. These are concentrated source of energy providing 9 kcal/gm. Fat was used by all the families in preparation of curry prepared out of vegetables and pulses, mean intake in LAL, MF and SF was 13, 14.15 and 13 g/day which was 33.0, 35.0 and 33.0 per cent of the balance diet (40 grams/day) whereas, in peak season consumption was almost same (LAL 13, MF 15 and SF 15.9 grams/day) as lean season (table-17a and 17b) which was lower (LAL 33.0%, MF 37.0% and SF 40.0%) than the balance diet (40 grams) given in Table-17a. The reason behind low consumption of fats and oils being the same i.e, low income of the families and fats and oils are costly food items.

The above results reveal that the diet of the farmwomen from all the landholding categories in both the seasons was notably inadequate with comparison to balance diet in all the food groups except that of cereals, roots and tubers, milk and milk products. A close view of Table-17a and 17b explains that daily diet of farmwomen from different land holding categories was cereal based with little consumption of other food items. The daily consumption of almost all the food items in all the landholding categories was slightly higher during peak season than in lean season. But still the difference was non significant in all the food groups (Table-17b).

Rajkumar and Premkumari (2000) also reported parallel findings, while studying food habits of working women. The study revealed that intake of protective food like green leafy vegetables, fruits and milk was considerably poor among female workers of construction sites cotton and weaving industries, when compared to RDA put forth by ICMR. The women mainly consumed cereal based diets.

### **c. Nutrient Intake**

Food is the conveyor of nutrients and consumption of adequate diet is required for the maintenance, repair, growth and development of the body (Gopalan et al, 1995). Nutrient requirement can be defined as the minimum amount of the absorbed nutrients that is necessary for maintaining the normal physiological function of the body. Since the requirement of a given individual in population can be determined precisely, a level of nutrient intake which covers the requirement of almost all the individual in the population is normally recommended. This is referred as the recommended dietary allowance or safe allowance. Hence RDA is defined as the nutrients in the diet which satisfy the daily requirement of nearly all the individuals in a population (Rao, 1999). Low intake of nutrient makes a significant contribution to poor anthropometric and biochemical nutritional status. Mean nutrient contents of the diets was calculated in terms of raw weight.

**i Energy:** Body needs energy for maintaining body temperature, metabolic activities, supporting growth and physical activities. Table-18a and 18b shows energy

intake in LAL was 11260 kJ/day (92.53 % of RDA), in MF it was 10294 kJ/day (84.0% of RDA) and in SF it was 10996 kJ/day (90.3% of RDA) in lean season. Whereas, during peak season energy intake was 11541, 11408 and 10691 kJ/day in LAL, MF and SF respectively, which was 94.84, 93.75 and 87.6 per cent of RDA (12168 kJ/day).

**ii Protein:** Dietary proteins provide amino acids for the synthesis of body protein and other biological important nitrogenous components in the body. Adequate protein is essential during growth, when new tissue proteins are being synthesized. In adults dietary protein is essential to synthesis new protein that will replace those which are constantly being broken down (ICMR, 1990). According Table-18a, average protein intake was 72, 70, and 71 grams/day in LAL, MF and SF respectively during lean season; it was 144.0, 140.0 and 142.0 per cent of RDA in Table-18b. Whereas; the daily intake was 74, 72 and 72 grams/day in peak agriculture season which was 148.0, 144.0 and 144.0 per cent of RDA (20 grams). Difference in daily intake during lean and peak season was non-significant. Cereals were contributing a considerable amount of protein to daily diet. But quality of cereal protein is poor as they are deficient in an essential amino acid lysine.

Bordia 1998, reported higher intake of protein among executive of Hindustan Zinc Ltd, Udaipur. In the diet of these executive pulses, milk and non-veg food were also contributing protein therefore quality of protein of their diet was better than the diet of the subjects of the present study.

**iii Fat:** Fat is provided in two form i.e. visible and invisible fat. Visible fat is provided from ghee, oil, butter etc and invisible fat are that which is present within the food like cereals, pulses, nuts etc. Fat is concentrated source of energy and it provides more than twice the energy furnished by either carbohydrate or protein along with this it also import palatability to the diet (Gopalan et al, 1989).

Table-18a Mean±SD nutrient intake of the respondents during lean and peak season

Nutrients		Categories of landholdings								
		LAL (n=6)			MF (n=6)			SF (n=6)		
		Lean season	Peak season	t-values	Lean season	Peak season	t-values	Lean season	Peak season	t-values
Energy (kJ)		11260±804	11541±740	0.174 NS	10294±1067	11408±779	0.252 NS	10996±670	10691±441	0.311 NS
Protein (grams)		72±5.4	74±4.6	0.82 NS	70±5.7	72±5.16	0.464 NS	71±4.6	72±4.5	0.119 NS
Fat (gms)	Total	39±17	41±8	0.365 NS	44±9.8	42±3.6	0.359 NS	44±9.2	34±2.63	0.933 NS
	Visible	13.7±3.18	13±2.67	0.212 NS	14.15±2.66	15.15±2.6	0.216 NS	13±3.01	15.9±5.16	0.059 NS
Carbohydrate		515±35	525±32	0.129 NS	508±36	517±84	0.312 NS	489±16	491±17	0.371 NS
Iron (mg)		11.33±1.5	11.16±1.3	0.53 NS	11.76±.76	11.83±.89	0.63 NS	12.5±1.26	12.56±1.23	0.93 NS

(N=18)

NS Non Significant

In the present study, total (visible + invisible) fat intake was 39, 47 and 46 gm/day in LAL, MF and SF respectively during lean season and 41, 51 and 43 gm/day in LAL, MF and SF respectively. Whereas; visible fat intake was 13.7, 14.15 and 13 grams respectively in LAL, MF and SF during lean season and it was about 68, 70 and 66 percent of RDA (20 gms/day) and during peak season the intake was 13, 15.15 and 15.9 grams/day which was 65.0, 75.0 and 79.5 percent of RDA respectively in LAL, MF and SF categories. But, the difference was non-significant between intake of fat during lean and peak agricultural season in all the three

Nutrients	RDA	Categories of landholdings					
		LAL (n=6)		MF (n=6)		SF (n=6)	
		Lean season	Peak season	Lean season	Peak season	Lean season	Peak season
Energy	12168 kJ*	92.53±6.60	94.84±6.8	84±10.36	93.75±6.4	90.3±5.5	87.86±3
Protein	50 grams	144±10.8	148±8	140±7	144±11	142±9	144±8
Fat(Visible)	20 grams	68.5±15.9	65±13	70±913.3	75±13	66.5±15	79.5±25
CHO	-	-	-	-	-	-	-
Iron	30 mg	38±.56	37±.39	39±.58	40±.63	41.6±.74	42±.97

categories of land holding (Table 18a and 18b).

**Table-18b Mean±SD Percent intake of RDA of the respondents in lean and peak agriculture season**  
RDA as Suggested by NIN (1998) for heavy worker women.

\* (2925 Kcal)

**iv Carbohydrate:** Carbohydrate is consumed in various forms like starch, glucose, cane sugar, milk sugar. Carbohydrate derived from cereals is the chief source of energy in Indian diet (Gopalan et al, 1989). Carbohydrate intake was calculated by different method (total energy – energy from fat and protein = energy from carbohydrate). Mean intake of carbohydrate in LAL, MF and SF was 515, 508 and 489 grams respectively in lean season. Whereas, in peak season it was slightly higher than lean season in LAL intake was 525 grams, in MF 517 grams and in SF it was 491 grams/day. Table-18b emphasis that difference in intake during lean and peak season for all categories was non-significant.

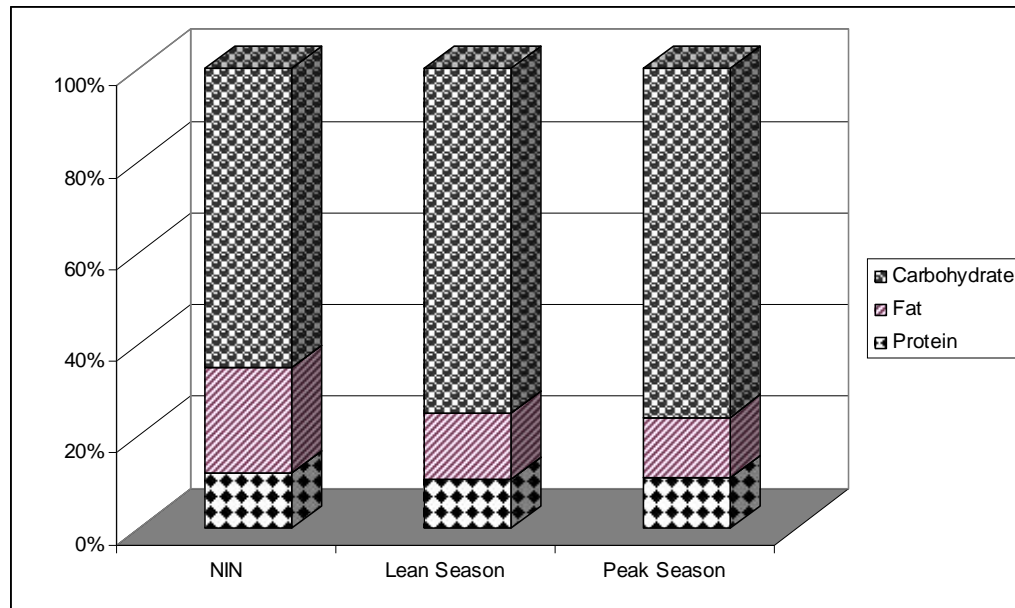
**v Energy Ratio:** NIN 1998, have suggested contribution of 10.0-12.0, 20.0-25.0, and 60.0-70.0 per cent respectively from protein, fat and carbohydrate in a balance diet. The percentage of energy provided from macro-nutrients was calculated and is systematically presented in Table-19. It was 10.6, 14.3 and 74.9 per cent of total energy intake during lean agriculture season from protein, fat and carbohydrate respectively and in peak season it was protein (10.9%), fat (13.2%) and carbohydrate (75.9%) of the total energy intake.

**Table-19 Energy ratio in the respondents**

Nutrients	Energy Percentage		
	NIN	Lean	Peak

		Season	Season
<b>Protein</b>	10.0-12.0	10.6	10.9
<b>Fat</b>	20.0-25.0	14.3	13.2
<b>Carbohydrate</b>	60.0-70.0	74.9	75.9

**Figure-14 Energy ratio in the respondents**



The close view of Figure-14 reveals that, contribution of energy from protein was same as NIN in both seasons but contribution of energy from fat was lower and carbohydrate was higher in the study group than that suggested by NIN, it may be due to higher intake of cereals and potato and low consumption of fats and oils, reason being high cost and low purchasing power.

Aujla et.al. (1983) reported energy intake of 2371-3119 Kcal per consumption unit per day in farm and non-farm households was more than the amount recommended (112% and 106% respectively). Similar findings of intake by heavy coal workers was reported by Bansal and Mehta (1985), Kaur and Sood (1988), Szponar and Mifeszko (1987) and Saxena et al (1996).

**vi Iron:** The intake was almost same in lean and peak season. It was 38, 39 and 41 percent of balance diet respectively, in LAL, MF and SF during lean season whereas; it was 37, 40 and 42 percent in peak season. Iron intake in diet was significantly lower than the balance diet (30 mg/day) recommended by NIN (1998). The reason was low consumption of green leafy vegetables, dry fruits, fruits and other iron rich food materials (Table-18a and 18b).

#### **4.4.3. Haemoglobin Level**

Haemoglobin determination is regarded as a screening index useful in defining various degree of iron deficiency (INACG, 1985). It has been recommended that anemia may be diagnosed carefully, confidently when the Haemoglobin concentration is lower than the level considered normal for the persons age/sex (Demaeayer, 1989).

#### **Table-20 Percentage distribution of respondents on the basis of Haemoglobin level**

<b>Haemoglobin level (g/dl)</b>	<b>Interpretation</b>	<b>LAL (n=6)</b>	<b>MF (n=6)</b>	<b>SF (n=6)</b>	<b>Total (N=18)</b>
<7	<b>Severe anemia</b>	0	0	0	0
<b>7-9.9</b>	<b>Moderate anemia</b>	66.7 (4)	100 (6)	83.3 (5)	83.3 (15)
<b>10-11.9</b>	<b>Mild anemia</b>	33.3 (2)	0	16.6 (1)	16.6 (3)
≥12	<b>Normal</b>	0	0	0	0

The Haemoglobin level of 18 subjects selected on the basis of BMI was estimated with the help of expert and given in Table-20. Overall review of the Table-20 demonstrates that no respondent from any of the land holding categories were normal and all were suffering from some degree of anemia. In LAL 66 percent, MF 100 percent and SF 83 percent were suffering from moderate anemia. And very few LAL (34%) and SF (17%) were suffering from mild anemia.

Similar findings were also observed in other studies Rathna (1994) noted that only 11.5 percent women had normal Haemoglobin level of 12-14 grams/100 ml blood. A study conducted in Mumbai, India reported that 82.2 per cent of non-pregnant women fell below recommended level of Haemoglobin (Bralim et.al, 2000). Suananda and Premkumari (1995) and Baghela (2001) reported that all the subjects under the study exhibited lower Hb range than standards. Above results shows that iron deficiency anemia is common among adult women in India.

#### **4.5 Energy Expenditure in daily activities**

The heart rate (HR) data while performing each agriculture activity was gathered as per details given in the chapter on

methodology. The heart rate is considered as one of the reliable data in order to arrive at energy expenditure in different activities especially in field situation or out of lab conditions. Hence, HR data for each activity was collected and Energy expenditure (EE) was calculated from heart rate of the activity and tabulated.

#### **4.5.1. Agriculture activities**

Systematic data regarding Average Working Heart Rate (AWHR), Energy Expenditure Rate (EER), Average Time Spent (ATS), Average Energy Expenditure (AEE) Total Cardiac Cost of Work (TCCW), and Physiological Cost of Work (PCW) in the agriculture activities is given in the Table-21 below:

**Table-21 Data of AWHR, AEER, ATS, AEE, TCCW and PCW in various agriculture activities**

Activities	Landholding categories	BMI Class	AWHR (beats/min)	AEER (kJ/min)	ATS (minute/day)	AEE (kJ/day)	TCCW (Beats)	PCW (Beats/min)
Land Preparation	LAL	CED	112	9	440	3960	788	26
		Normal	118	10	420	4183.2	735	25
		Obese	120	10	360	3729.6	850	28
		Mean	<b>117</b>	<b>9.8</b>	<b>406.7</b>	<b>3974.49</b>	<b>791</b>	<b>26</b>
	MF	CED	118	10	420	4216.8	945	32
		Normal	121	11	480	5044.8	933	31
		Obese	116	10	430	4214	830	28
		Mean	<b>118</b>	<b>10.1</b>	<b>443.3</b>	<b>4485.06</b>	<b>903</b>	<b>30</b>
	SF	CED	115	10	240	2280	830	28
		Normal	119	10	240	2448	890	30
		Obese	127	12	240	2760	1080	36
		Mean	<b>120</b>	<b>10.4</b>	<b>240.0</b>	<b>2496</b>	<b>933</b>	<b>31</b>
Mean			<b>118</b>	<b>10.10</b>	<b>363.33</b>	<b>3651.85</b>	<b>876</b>	<b>29</b>
Sowing	LAL	CED	88	5	470	2439.3	278	9
		Normal	96	6	405	2616.3	310	10
		Obese	97	7	470	3111.4	408	14
		Mean	<b>94</b>	<b>6.1</b>	<b>448.3</b>	<b>2730.35</b>	<b>332</b>	<b>11</b>
	MF	CED	90	6	200	1102	363	12
		Normal	93	5.98	200	1196	348	12
		Obese	95	6.38	210	1339.8	395	13
		Mean	<b>93</b>	<b>6.0</b>	<b>203.3</b>	<b>1211.19</b>	<b>369</b>	<b>12</b>
	SF	CED	87	5.5	130	715	358	12
		Normal	93	6	182	1092	425	14
		Obese	97	6.4	204	1305.6	475	16
		Mean	<b>92</b>	<b>6.0</b>	<b>172.0</b>	<b>1037.5</b>	<b>419</b>	<b>14</b>
Mean			<b>93</b>	<b>6.00</b>	<b>274.56</b>	<b>1648.55</b>	<b>373</b>	<b>12</b>
Weeding	LAL	CED	106	8.1	415	3361.5	740	25
		Normal	108	8.6	375	3225	733	24
		Obese	111	8.9	400	3560	708	23
		Mean	<b>108</b>	<b>8.5</b>	<b>396.7</b>	<b>3384.89</b>	<b>727</b>	<b>24</b>
	MF	CED	105	8.05	225	1811.25	690	23
		Normal	108	8.45	195	1647.75	693	23
		Obese	111	9.01	225	2027.25	695	23
		Mean	<b>108</b>	<b>8.5</b>	<b>215.0</b>	<b>1828.22</b>	<b>693</b>	<b>23</b>
	SF	CED	105	7.98	132	1053.36	688	23
		Normal	110	8.85	140	1239	753	25
		Obese	116	9.8	145	1421	798	27
		Mean	<b>110</b>	<b>8.9</b>	<b>139.0</b>	<b>1233.86</b>	<b>746</b>	<b>25</b>
Mean			<b>109</b>	<b>8.64</b>	<b>250.22</b>	<b>2161.36</b>	<b>722</b>	<b>24</b>
Harvesting	LAL	CED	108	8.5	470	3995	738	25
		Normal	115	9.6	415	3984	820	27
		Obese	117	10	415	4150	848	28
		Mean	<b>113</b>	<b>9.4</b>	<b>433.3</b>	<b>4058.89</b>	<b>802</b>	<b>27</b>
	MF	CED	108	8.4	350	2940	728	24
		Normal	111	8.9	325	2892.5	710	24
		Obese	121	10.4	365	3796	868	29
		Mean	<b>113</b>	<b>9.2</b>	<b>346.7</b>	<b>3200.89</b>	<b>769</b>	<b>26</b>
	SF	CED	108	8.4	150	1260	713	24
		Normal	113	9.2	140	1288	773	26
		Obese	134	12.6	150	1890	1157	39
		Mean	<b>118</b>	<b>10.1</b>	<b>146.7</b>	<b>1476.44</b>	<b>881</b>	<b>30</b>
Mean			<b>115</b>	<b>9.56</b>	<b>308.89</b>	<b>2951.6</b>	<b>817</b>	<b>28</b>

**a. Land Preparation**

Activities of land preparation consists of leveling land, stubble collection and this work is mainly performed by women in the farm. An overview of table depicts that average energy expenditure was highest in MF (4485 kJ/day) because average time devoted to the activity was highest among MF 443.3 minutes/day followed by LAL (406.7 minutes/day) and SF (240 min/day). On an average working heart rate (AWHR) was 118 beats/minute, highest was for SF (120 beats/min), with highest TCCW (933 beats) and PCW (31 beats/minute).

According to AICRP Annual Report (2003-4) AWHR for stubble collection was 111 beats/min, Average Energy Expenditure rate (AEER) was 8.94 kJ /min with TCCW-1022 beats and PCW- 34.07 beats/minute.

**b. Sowing**

Land preparation is followed by sowing. Data of sowing in table represents that AWHR, time spent and energy expenditure (EE) on the activity was highest in LAL i.e. 93 beats/minute, 448 minutes/day and 2730 kJ/day. TCCW and PCW was highest in SF it was 419 beats and 14 beats/minute respectively.

**c. Weeding**

AWHR was almost equal in all the categories of landholdings 108 beats/min in LAL and MF and 110 beats/min in SF. AEER was almost equal in all three categories but, energy

expenditure was highest in LAL 3348 kJ/day followed by MF 1935 kJ/day and lowest was in SF 1251 kJ/min. The difference was due to difference in time spent. TCCW and PCW was highest in SF 746 beats and 25 beats/min respectively.

According to Annual Report AICRP (2003-4) for weeding AWHR was 107 beats/min, AEER was 8.21 kJ/min, TCCW was 1009 beats and PCW was 27.16 beats/min and collaborating findings in Annual Report (1998) AWHR was 107 beats/min, AEER was 8.38 kJ/min, TCCW was 2954 and PCW was 27.87 beats/min.

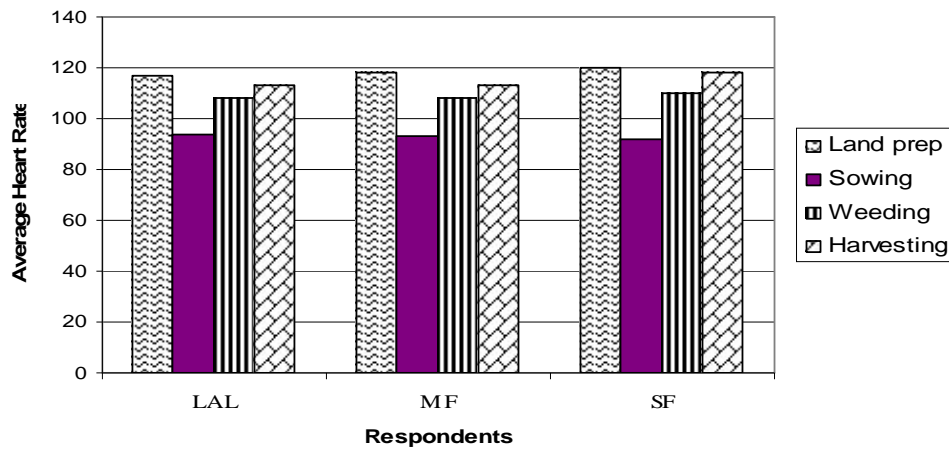
#### **d. Harvesting**

Data of harvesting shows that AWHR was highest in SF i.e. 118 beats/min. Whereas, EE was highest in LAL (4058 kJ/day) followed by MF (3200 kJ/min) and lowest was in SF (1476 kJ/min) as time spent on the activity was also decreasing in the same order i.e. 433, 346 and 146 min/day in LAL, MF and SF respectively. Again the TCCW and PCW were highest in SF 881 beats/min and 30 beats/min respectively.

Overall view of Table-21 emphasis the fact that Energy expenditure was highest for every activity in LAL and the reason is they spend more time on all agriculture activities because they work as paid labour so, they have to work for 8 hours or more per day. But, TCCW and PCW were highest in SF category of land holding. And among all activities AWHR was highest in land preparation, followed by weeding, than harvesting and lowest in sowing. Energy expenditure also followed same pattern highest in land preparation (3668 kJ/day) and lowest in sowing (1648 kJ/day). More time was spent on land preparation but lowest

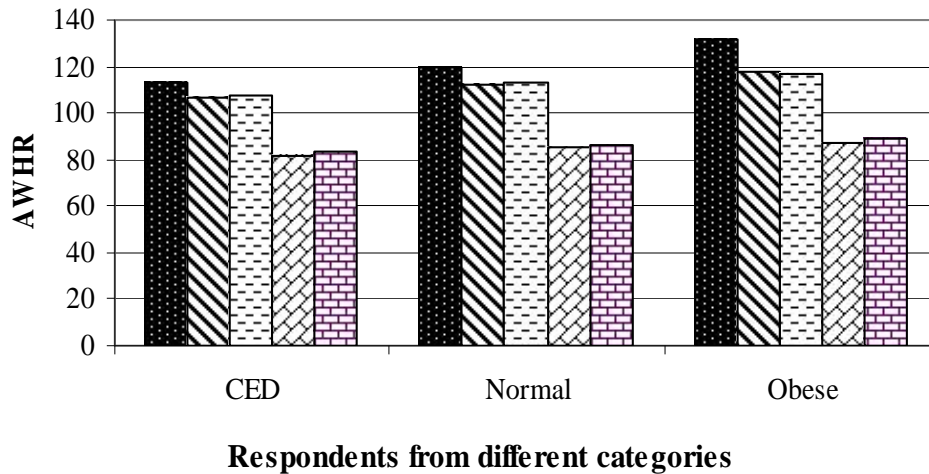
on weeding. In nut shell it can be concluded from Figure-15 that, land preparation was most time consuming, labour consuming and heavy activity followed by harvesting than weeding at last sowing which was less time and labour consuming.

**Figure-15 Average Heart Rate of the respondents from various BMI class in agriculture activities**



ities

**Figure 16 Average Working Heart Rate of the respondents from various BMI class in allied activities**



#### 4.5.2. Allied (dairy) activities

Organized data regarding AWHR, AEER, ATS, TCCW and PCW in lean and peak season is given in the Table-22.

##### a. Cutting and collecting fodder

The activity of cutting and collecting fodder consists of onward journey to field, cutting fodder, bundling and backward journey to home. AWHR (122 beats/min), time spent (87.4 minutes in lean season and 57.9 minutes in peak season), AEER (10.6 kJ/min), EE/day (925 kJ), TCCW (933 beats) and PCW (31 beats/minute) is almost equal for all respondents from all land holding categories, but EE/day was more in lean season than peak season, as time spend on the activity was more in lean season (87.4 min) than in peak season (57.9 minutes). The reason is time spent on onward and back ward journey was not included during peak season.

Same finding were reported in AICRP (1998-99) for cutting and collecting fodder viz. AWHR- 116.7 beats/min, AEER- 9.8 kJ/minute, TCCW- 2531 beats and PCW- 34.32 beats/min.

**Table-22 Data regarding AWHR, EER, time spent, TCCW, and PCW in allied (dairy) activities during lean and peak season**

Activities	Landholding categories	BMI class	AWHR (beats/min)	AEER (kJ/min)	Average time spent (minutes/day)		Average TEE (kJ/day)		TCCW (Beats)	PCW (Beats/m)
					Lean	Peak	Lean	Peak		
Cutting and collecting fodder	LAL	CED	114	9.3	85	57	790.5	530.1	853	28
		Normal	120	10.3	87	59	896.1	607.7	875	29
		Obese	132	12.2	89	61	1085.8	744.2	1045	35
		Mean	<b>122</b>	<b>10.6</b>	<b>87</b>	<b>59</b>	<b>922.2</b>	<b>625.4</b>	<b>924</b>	<b>31</b>
	MF	CED	112	9.1	84	58	764.4	527.8	838	28
		Normal	121	10.5	85	57	892.5	598.5	910	30
		Obese	132	12.2	92	59	1122.4	719.8	1110	37
		Mean	<b>122</b>	<b>10.6</b>	<b>87</b>	<b>58</b>	<b>922.2</b>	<b>614.8</b>	<b>953</b>	<b>32</b>
	SF	CED	113	9.2	92	53	846.4	487.6	838	28
		Normal	120	10.4	89	61	925.6	634.4	923	31
		Obese	131	12	84	56	1008	672	1013	Cont..
		Mean	<b>121</b>	<b>10.5</b>	<b>88.3</b>	<b>56.7</b>	<b>930.4</b>	<b>596.9</b>	<b>925</b>	<b>31</b>
Mean			<b>122</b>	<b>10.6</b>	<b>87.4</b>	<b>57.9</b>	<b>925.0</b>	<b>612.3</b>	<b>934</b>	<b>31</b>
Cleaning animal shed	LAL	CED	108	8.4	25	24	210	201.6	743	25
		Normal	113	9.2	30	29	276	266.8	745	25
		Obese	117	9.8	29	32	284.2	313.6	833	2 Cont..
		Mean	<b>113</b>	<b>9.1</b>	<b>28.0</b>	<b>28.3</b>	<b>255</b>	<b>258</b>	<b>774</b>	<b>25</b>
	MF	CED	109	8.5	38	29	323	246.5	770	26
		Normal	114	9.3	36	31	334.8	288.3	753	25
		Obese	119	10.2	39	30	397.8	306	820	27
		Mean	<b>114</b>	<b>9.3</b>	<b>37.7</b>	<b>30.0</b>	<b>351.55</b>	<b>280</b>	<b>781</b>	<b>26</b>
	SF	CED	105	8	31	30	248	240	680	23
		Normal	110	8.7	28	29	243.6	252.3	680	23
		Obese	118	10	31	31	310	310	767	26
		Mean	<b>111</b>	<b>8.9</b>	<b>30.0</b>	<b>30.0</b>	<b>267</b>	<b>267</b>	<b>709</b>	<b>24</b>
Mean			<b>113</b>	<b>9.1</b>	<b>31.9</b>	<b>29.4</b>	<b>290.9</b>	<b>268.6</b>	<b>755</b>	<b>25</b>
Milking	LAL	CED	107	8.3	40	40	332	332	740	25
		Normal	113	9.2	40	40	368	368	777	26
		Obese	117	10	40	40	400	400	885	30
		Mean	<b>112</b>	<b>9.2</b>	<b>40.0</b>	<b>40.0</b>	<b>366.7</b>	<b>366.7</b>	<b>801</b>	<b>27</b>
	MF	CED	108	8.5	40	40	340	340	755	25
		Normal	113	9.2	40	40	368	368	730	24
		Obese	117	9.8	40	40	392	392	770	26
		Mean	<b>113</b>	<b>9.2</b>	<b>40.0</b>	<b>40.0</b>	<b>366.7</b>	<b>366.7</b>	<b>752</b>	<b>25</b>
		CED	109	8.6	40	40	344	344	760	25
		Normal	114	9.3	40	40	372	372	745	25

	<b>SF</b>	<b>Obese</b>	118	10	40	40	400	400	775	26
		<b>Mean</b>	<b>114</b>	<b>9.3</b>	<b>40.0</b>	<b>40.0</b>	<b>372</b>	<b>372</b>	<b>760</b>	<b>25</b>
<b>Mean</b>			<b>113</b>	<b>9.2</b>	<b>40.0</b>	<b>40.0</b>	<b>368.4</b>	<b>368.4</b>	<b>771</b>	<b>26</b>
<b>Feeding animal</b>	<b>LAL</b>	<b>CED</b>	87	5	45	30	225	150	330	11
		<b>Normal</b>	89	5.4	49	30	264.6	162	293	10
		<b>Obese</b>	86	5	52	30	260	150	258	9
		<b>Mean</b>	<b>87</b>	<b>5.1</b>	<b>48.7</b>	<b>30.0</b>	<b>249.82</b>	<b>154</b>	<b>294</b>	<b>10</b>
	<b>MF</b>	<b>CED</b>	80	3.9	62	33	241.8	128.7	183	6
		<b>Normal</b>	84	4.6	60	28	276	128.8	160	5
		<b>Obese</b>	87	5.1	58	29	295.8	147.9	178	6
		<b>Mean</b>	<b>84</b>	<b>4.5</b>	<b>60.0</b>	<b>30.0</b>	<b>272</b>	<b>136</b>	<b>174</b>	<b>6</b>
	<b>SF</b>	<b>CED</b>	80	3.9	29	15	113.1	58.5	165	6
		<b>Normal</b>	83	4.5	31	15	139.5	67.5	145	5
		<b>Obese</b>	87	5.1	30	15	153	76.5	157	5
		<b>Mean</b>	<b>83</b>	<b>4.5</b>	<b>30.0</b>	<b>15.0</b>	<b>135</b>	<b>67.5</b>	<b>156</b>	<b>5</b>
<b>Mean</b>			<b>85</b>	<b>4.7</b>	<b>46.2</b>	<b>25.0</b>	<b>218.3</b>	<b>118.1</b>	<b>208</b>	<b>7</b>
<b>Making dung cake</b>	<b>LAL</b>	<b>CED</b>	83	4.4	31	30	136.4	132	243	8
		<b>Normal</b>	85	4.7	29	30	136.3	141	215	7
		<b>Obese</b>	87	5.1	30	30	153	153	270	Cont..
		<b>Mean</b>	<b>85</b>	<b>4.7</b>	<b>30.0</b>	<b>30.0</b>	<b>142</b>	<b>142</b>	<b>243</b>	<b>8</b>
	<b>MF</b>	<b>CED</b>	83	4.4	29	0	127.6	0	248	8
		<b>Normal</b>	86	5.4	32	0	172.8	0	208	7
		<b>Obese</b>	89	5.4	29	0	156.6	0	225	8
		<b>Mean</b>	<b>86</b>	<b>5.1</b>	<b>30.0</b>	<b>0.0</b>	<b>152</b>	<b>0</b>	<b>227</b>	<b>8</b>
	<b>SF</b>	<b>CED</b>	83	4.5	35	30	157.5	135	238	8
		<b>Normal</b>	87	5.1	32	30	163.2	153	218	7
		<b>Obese</b>	92	5.9	25	30	147.5	177	263	9
		<b>Mean</b>	<b>87</b>	<b>5.2</b>	<b>30.7</b>	<b>30.0</b>	<b>158</b>	<b>155</b>	<b>240</b>	<b>8</b>
<b>Mean</b>			<b>86</b>	<b>5.0</b>	<b>30.2</b>	<b>20.0</b>	<b>150.8</b>	<b>99.8</b>	<b>237</b>	<b>8</b>

## b. Cleaning animal shed

Study of Table-22 exhibits; on an average AWHR, AEER, time spent, EE, TCCW and PCW was 113 beats/minute, 9.1 kJ/minute, 31.9 minutes, 268.6 kJ/day, 755 beats and 25 beats/minute respectively. MF spent more time (37 min/day) than others on the activity during lean season. So, energy expenditure in MF was also high (351 kJ/day) during lean season.

Collaborating finding were reported by Singh et.al (2006) for cleaning animal shed viz. AWHR was 116 beats/minute, AEER was 9.7 kJ/min, time spent (84 minutes), TCCW 430 beats and PCW 19.5 beats/minutes.

### **c. Milking**

Table-22 demonstrate that AWHR (113 beats/min), AEER (9.2 kJ/min), time spent (40 min), EE (368.4 kJ/day), TCCW (771 beats) and PCW (26 beats/min) were almost same for all the respondents irrespective of landholding status or season. AICRP (1996-2001) in a report stated that AWHR for milking was 108 beats/min; AEER was 8.39 kJ/min.

### **d. Feeding animals**

Summary of table-22 disclose that on an average AWHR was (85 beats/min), AEER (4.7 kJ/min), time spent (46.2 min in lean season and 25 min in peak season), EE (218.3 kJ/day in lean season and 118.1 kJ/day in peak season), TCCW (208 beats) and PCW was (7 beats/min)

### **e. Making dung cake**

Dung cake is used as fuel for cooking in villages. The revision of table reveals that AWHR was approximately same in all categories LAL (85 beats), MF (86 beats/min) and SF (87 beats/min), AEER was 4.7, 5.1 and 5.2 kJ/min respectively in LAL, MF and SF, time spent was same (approximately 30 minutes) during lean and peak seasons in all categories except MF during peak season as they did not make dung cake in peak season infact they use dung for preparing manure. TCCW and PCW were 237 beats and 8 beats/minute, respectively.

In brief, it can be declared that cutting and collecting fodder was time, energy and labour consuming allied activity followed by milking whereas; making dung cake was least demanding activity.

### 4.5.3. Household activities

Prearranged data of AWHR, AEER, ATS, AEE, TCCW, and PCW during lean and peak season is presented in the Table-23.

#### a. Cooking

Cooking activity was sub-divided into morning tea lunch, after noon tea, dinner with cleaning of kitchen after cooking is over. Combined data of the complete cycle is represented in the Table-24. It shows that on an average AWHR was 88 beats/minute, AEER was 5.2 kJ/min, time spent (120.6 min in lean and 33.9 min in peak), TCCW was 256 beats and PCW was 9 beats/minutes. But, the energy expenditure was less in peak season (175.8 kJ/min) and more in lean season (625.5 kJ/minutes), reason being they spent less time on cooking during peak season. The average time spent on the cooking in lean season was 120.6 minutes/day in all land holding categories and during peak season it was 33.9 minutes in LAL and SF while, 40 minutes in MF category of landholding. Due to difference in time devoted to the activity TEE/day also differed i.e. LAL-624.6, MF- 616.0 and SF-636.0 kJ/day in lean season and LAL spent 162.6, MF-205.3 and SF-159.0 kJ/day in peak season, respectively (Table-24).

Collaborated finding were presented in a study in Moga district of Punjab Jindal et.al (2001) that energy expenditure for cooking was found to be more in medium (427.98 Calories/day) as compared to small (346.60 Calories/day) and large farm size category (364.67 Calories/day). Energy expenditure for cooking ranged from 1.31 Calories/minute to 1.54 Calories/minute and heart rate from 101.80-120.20 beats/minute as compared to 81.60-86.60 beats/minute at rest.

**Table- 23 Data regarding AWHR, EER, time spent, TCCW, and PCW in household activities during lean and peak season**

Ac tiv.	La nd ho ld	B M I cl	A W H R	A E E	Average time spent	Average TEE (kJ/day)	TCCW	PCW
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					(minutes/day)		Lean	Peak	(Beats)	s/min)
					Lean	Peak				
<b>a- Performed daily</b>										
<b>Cooking</b>	<b>LAL</b>	<b>CED</b>	84	4.6	123	30	565.8	138	280	9
		<b>Normal</b>	87	5.1	118	35	601.8	178.5	262	9
		<b>Obese</b>	91	5.7	124	30	706.8	171	252	12
		<b>Mean</b>	<b>87</b>	<b>5.1</b>	<b>121.7</b>	<b>31.7</b>	<b>624.6</b>	<b>162.6</b>	<b>265</b>	<b>10</b>
	<b>MF</b>	<b>CED</b>	85	4.7	122	41	573.4	192.7	283	9
		<b>Normal</b>	87	5	118	39	590	195	217	7
		<b>Obese</b>	91	5.7	120	40	684	228	250	8
		<b>Mean</b>	<b>88</b>	<b>5.1</b>	<b>120.0</b>	<b>40.0</b>	<b>616.0</b>	<b>205.3</b>	<b>250</b>	<b>8</b>
	<b>SF</b>	<b>CED</b>	85	4.7	120	30	564	141	270	9
		<b>Normal</b>	88	5.2	125	30	650	156	225	8
		<b>Obese</b>	93	6	115	30	690	180	265	9
		<b>Mean</b>	<b>89</b>	<b>5.3</b>	<b>120.0</b>	<b>30.0</b>	<b>636.0</b>	<b>159.0</b>	<b>253</b>	<b>9</b>
	<b>Mean</b>			<b>88</b>	<b>5.2</b>	<b>120.6</b>	<b>33.9</b>	<b>625.5</b>	<b>175.8</b>	<b>256</b>
<b>Washing utensils</b>	<b>LAL</b>	<b>CED</b>	87	5	90	30	450	150	330	11
		<b>Normal</b>	88	5.2	85	30	442	156	272	9
		<b>Obese</b>	93	6.2	80	30	496	186	387	13
		<b>Mean</b>	<b>89</b>	<b>5.5</b>	<b>85.0</b>	<b>30.0</b>	<b>464.7</b>	<b>164.0</b>	<b>330</b>	<b>11</b>
	<b>MF</b>	<b>CED</b>	85	4.7	60	0	282	0	290	8
		<b>Normal</b>	87	5	55	0	275	0	212	7
		<b>Obese</b>	89	5.4	65	0	351	0	210	7
		<b>Mean</b>	<b>87</b>	<b>5.0</b>	<b>60.0</b>	<b>0.0</b>	<b>302.0</b>	<b>0.0</b>	<b>237</b>	<b>7</b>

Cont....

	SF	CED	85	4.7	85	60	399.5	282	270	9	
		Normal	88	5.2	95	60	494	312	225	8	
		Obese	91	5.7	90	60	513	342	225	8	
		Mean	<b>88</b>	<b>5.2</b>	<b>90.0</b>	<b>60.0</b>	<b>468.0</b>	<b>312.0</b>	<b>240</b>	<b>9</b>	
Mean			<b>88</b>	<b>5.2</b>	<b>78.3</b>	<b>30.0</b>	<b>409.9</b>	<b>157.0</b>	<b>269</b>	<b>9</b>	
Washing Clothes	LAL	CED	104	7.9	110	0	869	0	690	23	
		Normal	107	8.3	115	0	954.5	0	662	22	
		Obese	111	9	120	0	1080	0	767	26	
		Mean	<b>107</b>	<b>8.4</b>	<b>115.0</b>	<b>0.0</b>	<b>966.0</b>	<b>0.0</b>	<b>706</b>	<b>24</b>	
	MF	CED	103	7.6	120	60	912	456	655	22	
		Normal	109	8.6	110	60	946	516	675	23	
		Obese	113	9.2	120	60	1104	552	690	23	
		Mean	<b>108</b>	<b>8.5</b>	<b>116.7</b>	<b>60.0</b>	<b>987.8</b>	<b>508.0</b>	<b>673</b>	<b>23</b>	
	SF	CED	109	8.5	60	35	510	297.5	767	26	
		Normal	113	9.2	60	35	552	322	755	25	
		Obese	119	10.2	60	35	612	357	785	26	
		Mean	<b>114</b>	<b>9.3</b>	<b>60.0</b>	<b>35.0</b>	<b>558.0</b>	<b>325.5</b>	<b>769</b>	<b>26</b>	
	Mean			<b>110</b>	<b>8.7</b>	<b>97.2</b>	<b>31.7</b>	<b>848.0</b>	<b>276.2</b>	<b>716</b>	<b>24</b>
	Fetching Water	LAL	CED	114	9.3	60	60	558	558	875	29
			Normal	118	10	60	60	600	600	877	30
			Obese	116	9.6	60	60	576	576	837	28
Mean			<b>116</b>	<b>9.6</b>	<b>60.0</b>	<b>60.0</b>	<b>578.0</b>	<b>578.0</b>	<b>863</b>	<b>29</b>	
MF		CED	110	8.7	60	60	522	522	790	26	
		Normal	113	9.2	60	60	552	552	735	25	

		Obese	115	9.5	60	60	570	570	727	24	
		Mean	<b>113</b>	<b>9.1</b>	<b>60.0</b>	<b>60.0</b>	<b>548.0</b>	<b>548.0</b>	<b>751</b>	<b>25</b>	
	SF	CED	114	9.5	60	60	570	570	875	29	
		Normal	118	10	60	60	600	600	877	29	
		Obese	116	9.6	60	60	576	576	835	28	
		Mean	<b>116</b>	<b>9.7</b>	<b>60.0</b>	<b>60.0</b>	<b>582.0</b>	<b>582.0</b>	<b>862</b>	<b>29</b>	
Mean		<b>115</b>	<b>9.5</b>	<b>60.0</b>	<b>60.0</b>	<b>569.3</b>	<b>569.3</b>	<b>825</b>	Cont....		
Personal Care	LAL	CED	77	3.5	60	60	210	210	215		
		Normal	79	3.8	60	60	228	228	173	6	
		Obese	81	4.2	60	60	252	252	180	6	
		Mean	<b>79</b>	<b>3.8</b>	<b>60.0</b>	<b>60.0</b>	<b>230.0</b>	<b>230.0</b>	<b>189</b>	<b>6</b>	
	MF	CED	77	3.52	60	60	211.2	211.2	140	5	
		Normal	85	4.8	60	60	288	288	185	6	
		Obese	85	4.8	60	60	288	288	138	5	
		Mean	<b>82</b>	<b>4.4</b>	<b>60.0</b>	<b>60.0</b>	<b>262.4</b>	<b>262.4</b>	<b>154</b>	<b>5</b>	
	SF	CED	77	3.5	60	60	210	210	113	4	
		Normal	79	3.8	60	60	228	228	125	4	
		Obese	81	4.2	60	60	252	252	139	5	
		Mean	<b>79</b>	<b>3.8</b>	<b>60.0</b>	<b>60.0</b>	<b>230.0</b>	<b>230.0</b>	<b>126</b>	<b>4</b>	
	Mean		<b>80</b>	<b>4.0</b>	<b>60.0</b>	<b>60.0</b>	<b>240.8</b>	<b>240.8</b>	<b>156</b>	<b>5</b>	
	Child Care	LAL	CED	78	3.7	60	60	222	222	155	5
			Normal	83	4.5	60	60	270	270	118	4
			Obese	85	4.9	60	60	294	294	135	5
Mean			<b>82</b>	<b>4.4</b>	<b>60.0</b>	<b>60.0</b>	<b>262.</b>	<b>262.</b>	<b>136</b>	<b>5</b>	

							<b>0</b>	<b>0</b>		
	<b>MF</b>	<b>CED</b>	77	3.5	60	60	210	210	140	5
		<b>Normal</b>	82	4.2	60	60	252	252	115	4
		<b>Obese</b>	85	4.8	60	60	288	288	138	5
		<b>Mean</b>	<b>81</b>	<b>4.2</b>	<b>60.0</b>	<b>60.0</b>	<b>250.0</b>	<b>250.0</b>	<b>131</b>	<b>5</b>
	<b>SF</b>	<b>CED</b>	78	3.7	60	60	222	222	110	4
		<b>Normal</b>	83	4.5	60	60	270	270	147	5
		<b>Obese</b>	86	4.9	60	60	294	294	130	4
		<b>Mean</b>	<b>82</b>	<b>4.4</b>	<b>60.0</b>	<b>60.0</b>	<b>262.0</b>	<b>262.0</b>	<b>129</b>	<b>4</b>
<b>Mean</b>		<b>82</b>	<b>4.3</b>	<b>60.0</b>	<b>60.0</b>	<b>258.0</b>	<b>258.0</b>	<b>132</b>	<b>5</b>	
<b>Mopping</b>	<b>LAL</b>	<b>CED</b>	104	7.7	0	0	0	0	670	22
		<b>Normal</b>	107	8.3	0	0	0	0	675	23
		<b>Obese</b>	110	8.8	0	0	0	0	735	25
		<b>Mean</b>	<b>107</b>	<b>8.3</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>693</b>	<b>23</b>
	<b>MF</b>	<b>CED</b>	104	7.9	25	17.5	197.5	138.25	652	Cont.. 22
		<b>Normal</b>	107	8.3	25	25	207.5	207.5	627	21
		<b>Obese</b>	110	8.8	25	25	220	220	640	21
		<b>Mean</b>	<b>107</b>	<b>8.3</b>	<b>25.0</b>	<b>22.5</b>	<b>208.3</b>	<b>187.5</b>	<b>640</b>	<b>21</b>
	<b>SF</b>	<b>CED</b>	104	7.8	30	0	234	0	628	21
		<b>Normal</b>	108	8.4	30	0	252	0	638	21
		<b>Obese</b>	112	9.1	30	0	273	0	655	22

		Mean	108	8.4	30.0	0.0	253.0	0.0	640	21	
Mean			107	8.3	18.3	7.5	153.0	62.6	658	22	
Sweeping	LAL	CED	115	9.5	60	30	570	285	852	28	
		Normal	119	10.2	60	30	612	306	895	30	
		Obese	122	10.7	60	30	642	321	977	33	
		Mean	119	10.1	60.0	30.0	608.0	304.0	908	30	
	MF	CED	113	9.2	60	30	552	276	865	29	
		Normal	119	10.3	60	30	618	309	865	29	
		Obese	130	10.8	60	30	648	324	900	30	
		Mean	121	10.1	60.0	30.0	606.0	303.0	877	29	
	SF	CED	113	9.2	60	30	552	276	835	28	
		Normal	117	9.9	60	30	594	297	825	28	
		Obese	121	10.5	60	30	630	315	832	28	
		Mean	117	9.9	60.0	30.0	592.0	296.0	831	28	
	Mean			119	10.0	60.0	30.0	602.0	301.0	872	29
	<b>b- Performed weekly</b>										
	Cutting and loading	LAL	CED	117	9.9	480	0	4752	0	875	29
			Normal	120	10.4	480	0	4992	0	922	31

		<b>Obese</b>	122	10.6	480	0	5088	0	972	32	
		<b>Mean</b>	<b>120</b>	<b>10.3</b>	<b>480.0</b>	<b>0.0</b>	<b>4944.0</b>	<b>0.0</b>	<b>923</b>	<b>31</b>	
	<b>MF</b>	<b>CED</b>	117	9.8	480	0	4704	0	897	30	
		<b>Normal</b>	119	10.1	480	0	4848	0	860	29	
		<b>Obese</b>	122	10.6	480	0	5088	0	872	Cont 29	
		<b>Mean</b>	<b>119</b>	<b>10.2</b>	<b>480.0</b>	<b>0.0</b>	<b>4880.0</b>	<b>0.0</b>	<b>876</b>	<b>29</b>	
	<b>SF</b>	<b>CED</b>	115	9.6	480	0	4608	0	862	29	
		<b>Normal</b>	119	10.2	480	0	4896	0	862	29	
		<b>Obese</b>	123	10.8	480	0	5184	0	875	29	
		<b>Mean</b>	<b>119</b>	<b>10.2</b>	<b>480.0</b>	<b>0.0</b>	<b>4896.0</b>	<b>0.0</b>	<b>866</b>	<b>29</b>	
	<b>Mean</b>		<b>119</b>	<b>10.2</b>	<b>480.0</b>	<b>0.0</b>	<b>4906.7</b>	<b>0.0</b>	<b>888</b>	<b>30</b>	
	<b>Mud Plastering</b>	<b>LAL</b>	<b>CED</b>	113	9.2	180	0	1656	0	825	28
			<b>Normal</b>	117	9.8	180	0	1764	0	852	28
			<b>Obese</b>	121	10.5	180	0	1890	0	865	32
<b>Mean</b>			<b>117</b>	<b>9.8</b>	<b>180.0</b>	<b>0.0</b>	<b>1770.0</b>	<b>0.0</b>	<b>847</b>	<b>29</b>	
<b>MF</b>		<b>CED</b>	116	9.7	180	0	1746	0	927	31	
		<b>Normal</b>	119	10.2	180	0	1836	0	867	29	
		<b>Obese</b>	121	10.	180	0	1890	0	857	27	

			5						
	<b>Mean</b>	<b>119</b>	<b>10.1</b>	<b>180.0</b>	<b>0.0</b>	<b>1824.0</b>	<b>0.0</b>	<b>884</b>	<b>29</b>
<b>SF</b>	<b>CED</b>	116	9.7	180	0	1746	0	927	31
	<b>Normal</b>	119	10.2	180	0	1836	0	867	29
	<b>Obese</b>	121	10.5	180	0	1890	0	857	29
	<b>Mean</b>	<b>119</b>	<b>10.1</b>	<b>180.0</b>	<b>0.0</b>	<b>1824.0</b>	<b>0.0</b>	<b>884</b>	<b>30</b>
<b>Mean</b>		<b>118</b>	<b>10.0</b>	<b>180.0</b>	<b>0.0</b>	<b>1806.0</b>	<b>0.0</b>	<b>872</b>	<b>29</b>

### b. Washing Utensils

AWHR for washing utensils was almost same for the all land holding categories i.e. LAL (89 beats/minute), MF (87 beats/minute) and SF (88 beats/minute) AEER was also approximately same but the time devoted to the activity varied with landholdings and season as in lean season it was 85 min, 60 min and 90 min/day respectively in LAL, MF and SF whereas in peak season it was 30 min for LAL and 60 min/day for SF and contribution of respondents in MF category was negligible so data was not recorded. Total energy expenditure of the activity also varied with the time spent on it i.e. 464.7 kJ/day, 302 kJ/day and 468 kJ/day respectively in LAL, MF and SF during lean season and in peak season it was 164 kJ/day in LAL and 312 kJ/day in SF.

### c. Washing Clothes

Data for complete cycle of washing clothes is given in the Table-23 systematically. It reveals that AWHR was highest in SF (114/minute) followed by MF (108 beats/minute) and

lowest in LAL (107 beats/minute). AEER also decreased in the same manner 9.3, 8.5 and 8.4 kJ/min in SF, MF and LAL category respectively. Time devoted to the activity during lean season was almost same (115 min) in LAL and MF whereas, it was just half (60 minutes) in SF. And like other activities time spent on washing activity also decreased in peak season to 60 minutes in MF category and 35 minutes in SF category and contribution of LAL was negligible during peak season as they devoted less time to household activities during peak season because they work as paid labour. Total energy expenditure was almost equal i.e. 966.0 kJ/day and 987.8 kJ/day in LAL and MF respectively while it was 558.0 kJ/day in SF during lean season.

#### **d. Fetching water**

The activity can be divided into onward journey to water source, taking out water from well/pumping water from hand pump and backward journey. But data in the table is for complete cycle of fetching water. On an average AWHR was 115 beats/min, AEER was 9.5 kJ/min given to the activity in lean and peak season was same 60 minutes/day and total energy expenditure was 569.3 kJ/day and was approximately same for all the respondents regardless of landholding categories and season.

#### **e. Personal care**

The activity consisted of eating, bathing, dressing, undressing, going to out-house for urinate -defecate. But the data is represented in pooled form, AWHR (79 beats/min), AEER (3.8 kJ/min), time spent (60 minutes), and Total energy expenditure (230 kJ/minute) was same for LAL and SF in both

the seasons. But, in MF AWHR was 82 beats/min, AEER was 4.4 kJ/min, time 60 min/day and EE was 262.4 kJ/day.

#### **f. Child care**

The child care included bathing, helping them to eat, combing, dressing-undressing the child etc. But the data is given in joint form in the table. The study of the data shows that the values of AWHR, AEER etc are almost same. So, on an average it can be concluded that AWHR was 82 beats/minute, AEER was 4.3 kJ/min, time spent was 60 min/day in both lean and peak season and EE was 258 kJ/day in both seasons.

#### **g. Mopping**

This activity was not necessarily performed by respondents of all the categories. This was done only by the respondents with pucca houses and cemented flooring. So, LAL was not doing the activity as they had kuccha or semi-pucca houses. In MF AWHR (107 beats/min), AEER (8.3 kJ/min), time spent 25 min in lean season and in peak season for SF AWHR (108 beats/min), AEER (8.4 kJ/min), time spent 30 min. Also SF do not perform the activity in peak season and EE was 208.3 kJ/day for MF and 253.0 kJ/min for SF in lean season and 187.5 kJ/day for MF in peak season.

#### **h. Sweeping**

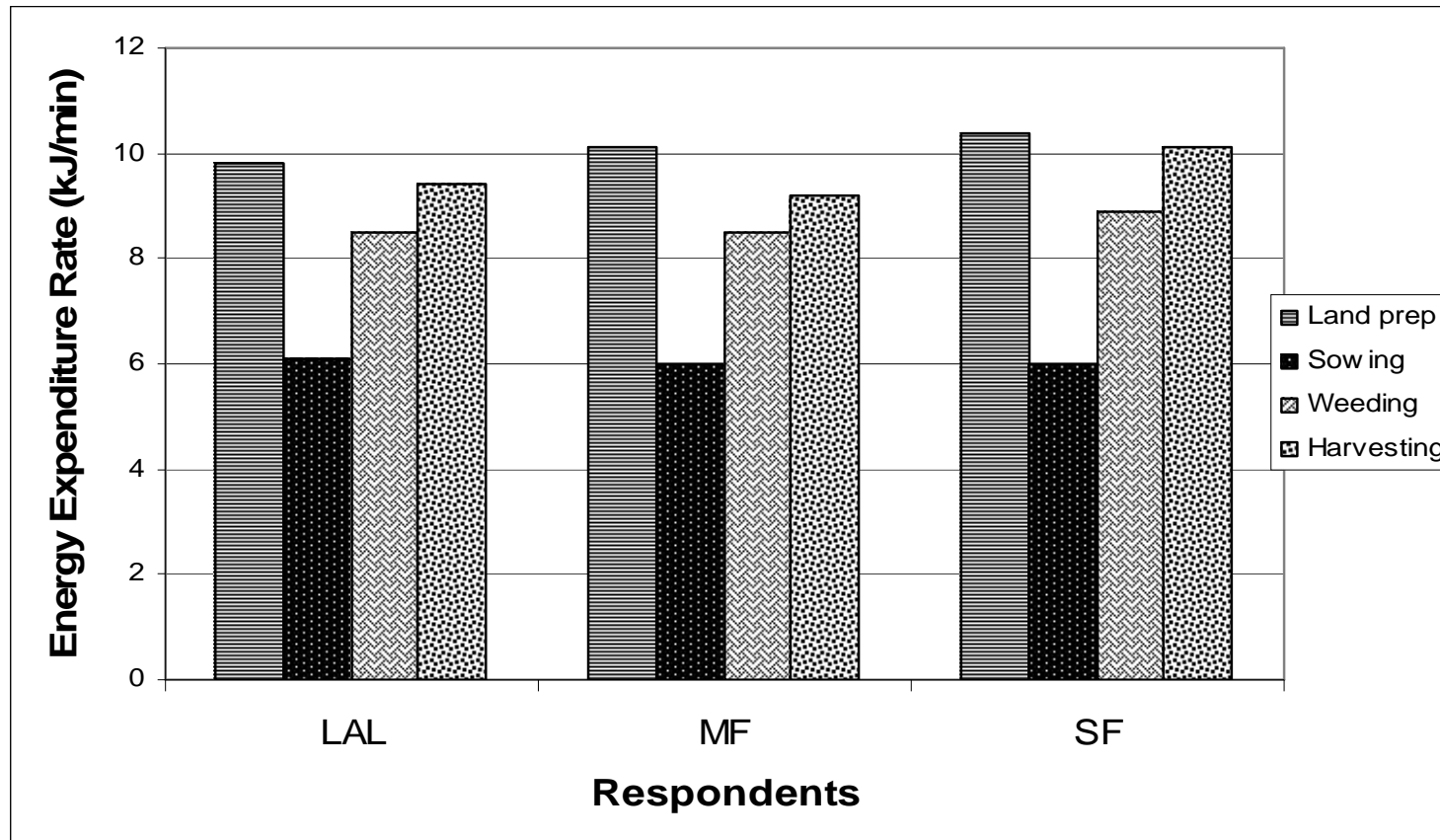
This activity was done with traditional short handle broom in bending and squatting position. AWHR and AEER were different for all the categories i.e. AWHR was 119, 121 and 117 beats/min in LAL, MF and SF respectively. AEER was 10.1 kJ/min for LAL, MF and 9.9 kJ/min for small farmers. Time spent by all the respondents of all the categories was same in both the season i.e. 60 min/day in lean season and 30

min/day in peak season. EE was 608, 606 and 592 kJ/min respectively in LAL, MF and SF during lean season whereas, 304, 303 and 296 kJ/day during peak season (Table-23).

**i. Cutting and collecting wood**

This activity was performed weekly, forth nightly or when ever needed but not in the peak season. The wood was collected when there was abundant of it for the period of scarcity. It can be regarded as very heavy, time and labour demanding activity. AWHR was 119 beats/min, AEER was 10.2 kJ/min, time spent on it was a whole man day i.e. 480 min and EE was 4906.7 kJ/day.

Figure-17 Average Working Heart Rate of the respondents from different BMI class in household activities



#### **j. Mud Plastering**

Like cutting and collecting wood this activity was performed monthly, quarterly, on ceremonies, at the time of festivals or whenever needed but not at time of peak agriculture season. This activity was also demanding in terms of time, energy and labour. Unlike cutting and collecting wood this activity was performed only by respondents with kaccha or semi-pucca houses so, SF was not involved in the activity. In LAL and MF the AWHR, AEER, time spent and EE was almost same i.e. 118 beats/min, 10 kJ/min, 180 min/day and EE 1770 (LAL) and 1824 kJ/day (MF).

It can be concluded from the Table-23 that from daily performed activities cooking was most time consuming whereas washing clothes was most energy consuming activity and lowest AWHR and EER was in personal care during lean season and cutting and collecting wood was the most energy and time consuming activity in weekly performed activities (Table-17).

## **4.6 Total Daily Energy Expenditure (TDEE)**

### **4.6.1. Lean Season**

Persual of Table-24 explains that washing clothes among household activities was most energy consuming (838 kJ/day) activity and fodder cutting was most energy consuming (926 kJ day) activity in dairy, irrespective of landholding categories. Cooking (625 kJ), fetching water (569 kJ), sweeping (602 kJ) were also amongst high energy demanding activities.

Whereas; child care (258 kJ) and personal care (241 kJ) were comparatively low energy demanding activities. Highest total energy expenditure was in MF (11056 kJ/day), followed by LAL (11041 kJ/day) and lowest was in SF (10793 kJ/day). And in BMI categories highest TEED was in Obese (11750 kJ in LAL, 12339 in MF and 11535 in SF), followed by Normal (11185 kJ in LAL, 10629 kJ in MF and 10986 kJ in SF) and lowest in CED (10188 kJ in LAL, 10199 kJ in MF and 9858 kJ in SF).

**Table-24 Data regarding Total Daily Energy Expenditure (TDEE) during Lean Season**

\* Represents Total energy expenditure in routine household and dairy activities

Categories of landholding	Categories of BMI	Energy Expenditure in activities performed daily by respondents in lean season (in kJ)														BMR (kJ/day)	TDEE (kJ/day)
		cooking	Washing utensils	Washing clothes	Fetching water	Personal care	Child care	Sweeping	Mopping	cutting & collecting fodder	Feeding animals	Making dung cake	Milking	Cleaning animal shed	Total*		
LAL	<b>CED</b>	565	450	869	558	210	222	570	0	790.5	210	332	225	136.4	5137	5050	10188
	<b>Normal</b>	601	442	954	600	228	270	612	0	896.1	276	368	264.6	136.3	5648	5536	11185
	<b>Obese</b>	706	496	1080	576	252	294	642	0	1085	284.2	400	260	153	6229	5521	11750
	<b>Mean</b>	<b>624</b>	<b>462.</b>	<b>967</b>	<b>578</b>	<b>230</b>	<b>262</b>	<b>608</b>	<b>0</b>	<b>924.1</b>	<b>256.7</b>	<b>366.7</b>	<b>249.9</b>	<b>141.9</b>	<b>5671</b>	<b>5369</b>	<b>11041</b>
MF	<b>CED</b>	573	282	912	522	211.2	210	552	197.5	764.4	323	340	241.8	127.6	5256	4943	10199
	<b>Normal</b>	590	275	946	552	288	252	618	207.5	892.5	334.8	368	276	172.8	5772	4857	10629
	<b>Obese</b>	684	351	1104	570	288	288	648	220	1122	397.8	392	295.8	156.6	6517	5822	12339
	<b>Mean</b>	<b>615.7</b>	<b>302.</b>	<b>987</b>	<b>548</b>	<b>262.4</b>	<b>250</b>	<b>606</b>	<b>208.3</b>	<b>926.4</b>	<b>351.9</b>	<b>366.7</b>	<b>271.2</b>	<b>152.3</b>	<b>5848</b>	<b>5207</b>	<b>11056</b>
SF	<b>CED</b>	564	399	510	570	210	222	552	234	846.4	248	344	113.1	157.5	4970	4888	9858
	<b>Normal</b>	650	494	552	600	228	270	594	252	925.6	243.6	372	139.5	163.2	5483	5503	10986
	<b>Obese</b>	690	513	612	576	252	294	630	273	1008	310	400	153	147.5	5858	5677	11535
	<b>Mean</b>	<b>634.7</b>	<b>468</b>	<b>558</b>	<b>582</b>	<b>230</b>	<b>262</b>	<b>592</b>	<b>253</b>	<b>926.7</b>	<b>267.2</b>	<b>372</b>	<b>135.2</b>	<b>156.1</b>	<b>5437</b>	<b>5356</b>	<b>10793</b>
<b>Mean</b>	<b>625</b>	<b>411</b>	<b>838</b>	<b>569</b>	<b>241</b>	<b>258</b>	<b>602</b>	<b>154</b>	<b>926</b>	<b>292</b>	<b>368</b>	<b>219</b>	<b>150</b>	<b>5652</b>	<b>5310</b>	<b>10963</b>	

TDEE= Energy expenditure from routine activities + BMR

#### **4.6.2. Peak season**

Farm women toil hard in labour from early morning till late night. Demand on their time and energy increases all the more in peak agriculture season, as during this period in addition to completion of time bound agriculture action there is no escape from daily chores. The energy expenditure in routine activities, in peak season activity and Total Daily Energy Expenditure (TDEE) of the respondents during different peak season activities are given below:

##### **a. Land Preparation**

There is considerable participation of women in land preparation activity be it kharif or Rabi season. Table-25 clearly exhibits Energy Expenditure pattern of farm women from different land holding categories with variable nutritional status as evidenced from their BMI categories. It is depicted that in LAL category women in CED grade spent maximum total energy per day (11839 kJ/day) during land preparation. It is a point of concern that, these women already deficient in energy are spending maximum energy in peak season. The reason may be they work as paid laborer and exert themselves beyond their capacity for bread and butter. Other peculiar trend evident from the table is obese women from all the land holding categories except LAL spent high total energy (13361 kJ in MF and 11451 kJ in SF) from their counterpart with normal and CED grade of BMI, as with obesity resulting due to more body weight the physiological effort in physical performance increase resulting in higher expenditure of energy. The total average value of energy expenditure shows that women from MF category of landholding spent marginally

higher energy (13361 kJ) as compared to respondents from LAL (12524 kJ) and SF (11451 kJ) during peak season in land preparation. This may be due to the fact that LAL escape some of the daily activities or devote less time to household and dairy activities (3251 kJ) as they work as paid labour during Peak season. While respondents

Table-25 Data regarding TDEE during peak agriculture activity- Land Preparation

Categories of landholding	Categories of BMI	Energy Expenditure in activities daily performed by respondents in peak season (Land Preparation) (in kJ)															BMR (kj/day)	TDEE (kj/day)
		cooking	Washing utensils	Washing clothes	Fetching water	Personal care	Child care	Mopping	Sweeping	Cutting and collecting fodder	Feeding animals	Making dung cake	Milking	Cleaning animal shed	Total *	Land Preparation		
LAL	CED	138	150	0	558	210	222	0	285	530.1	201	332	150	132	2908	3960	4970	11839
	Normal	178	156	0	600	228	270	0	306	607.7	266	368	162	141	3283	4183	5496	12963
	Obese	171	186	0	576	252	294	0	321	744.2	313	400	150	153	3560	3729	5481	12771
	Mean	<b>162</b>	<b>164</b>	<b>0</b>	<b>578</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>304</b>	<b>627.3</b>	<b>260</b>	<b>366</b>	<b>154</b>	<b>142</b>	<b>3251</b>	<b>4070</b>	<b>5316</b>	<b>12524</b>
MF	CED	192	0	456	522	211	210	138	276	527.8	246	340	128	0	3248	4216	4943	12408
	Normal	195	0	516	552	288	252	208	309	598.5	288	368	128	0	3703	5044	4857	13605
	Obese	228	0	552	570	288	288	220	324	719.8	306	392	147	0	4035	4214	5822	14072
	Mean	<b>205</b>	<b>0</b>	<b>508</b>	<b>548</b>	<b>262</b>	<b>250</b>	<b>189</b>	<b>303</b>	<b>615.37</b>	<b>280</b>	<b>366</b>	<b>135</b>	<b>0</b>	<b>3662</b>	<b>4430</b>	<b>5207</b>	<b>13361</b>
SF	CED	141	282	297	570	210	222	0	276	487.6	240	344	58.5	135	3263	2280	4848	10392
	Normal	156	312	322	600	228	270	0	297	634.4	252	372	67.5	153	3664	2448	5483	11595
	Obese	180	342	357	576	252	294	0	315	672	310	400	76.5	177	3952	2760	5657	12369
	Mean	<b>159</b>	<b>312</b>	<b>325</b>	<b>582</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>296</b>	<b>598</b>	<b>267</b>	<b>372</b>	<b>67.5</b>	<b>155</b>	<b>3626</b>	<b>2400</b>	<b>5329</b>	<b>11451</b>
Mean		<b>175</b>	<b>159</b>	<b>278</b>	<b>569</b>	<b>241</b>	<b>258</b>	<b>63</b>	<b>301</b>	<b>614</b>	<b>269</b>	<b>368</b>	<b>119</b>	<b>99</b>	<b>3513</b>	<b>3633</b>	<b>5284</b>	<b>12446</b>

\* Represents Total energy expenditure in routine household and dairy activities

TDEE= Energy expenditure from routine activities +Energy expenditure in Land Preparation + BMR

from MF categories has no escape from these routine activities and additionally have to work in the farm whereas respondent from SF give more time and efforts to routine activity and work less in fields as compared to their counterpart.

#### **b. Sowing**

It is evident from the Table-26 that in sowing activity of Peak season respondents from LAL category spent maximum energy per day (2688 kJ/) as compared to respondents from MF (1218 kJ) and SF (1032 kJ). The probable reason for the difference is attributed to be the same that, LAL work as paid labour and devote more time and energy to the peak agricultural activities than household and dairy activities during peak season. And same trend is observed in TDEE. Study of table also make it clear that additional demand of energy in peak season were compensated by eliminating some routine household activities like sweeping, washing utensils, cooking, cleaning animal shed etc. This was done by delegating tasks to other family members or putting in less time to some of the daily routine activities.

#### **c. Weeding**

Persual of Table-27 shows data in agreement with TDEE during different agriculture activities of peak season. Various studies have confirmed that weeding is a time bound activity predominantly performed by women. Similar results were also observed from the study too depicting that woman from LAL categories spent maximum mean energy (3573 kJ) in weeding as respondents from this category are hired. This was followed by MF category (1935 kJ) and than SF (1251 kJ). The reason for low energy expenditure in SF category was may be their better economic status than LAL because of which they devote comparatively less time in agriculture activities and hire labour for additional demand.

#### **d. Harvesting**

It was observed from Table-28 that respondents from LAL category spent maximum energy per day in harvesting activities (3897 kJ/day) as compared to the respondents from MF (3123 kJ/day) and SF (1470 kJ/day) category of landholding. The reason being same LAL devote more time in Agriculture activity as they are hired labour. But the grand total (TDEE) exhibit marginal difference between respondents from various landholding categories viz LAL (12609 kJ), MF (12079 kJ) and SF (10435 kJ) per day.

**Table-26 Data regarding TDEE during peak agriculture activity- Sowing**

Categories of landholding	Categories of BMI	Energy Expenditure in activities daily performed by respondents in peak season (sowing) (in kJ)															BMR (kJ/day)	Total EE (kJ/day)
		cooking	Washing utensils	Washing clothes	Fetching water	Personal care	Child care	Mopping	Sweeping	Cutting and collecting fodder	Feeding animals	Making dung cake	Milking	Cleaning animal shed	Total * (kJ)	Sowing (kJ)		
LAL	<b>CED</b>	138	150	0	558	210	222	0	285	530.1	201	332	150	132	2908	2439	4970	10318
	<b>Normal</b>	178	156	0	600	228	270	0	306	607.7	266	368	162	141	3283	2616	5496	11396
	<b>Obese</b>	171	186	0	576	252	294	0	321	744.2	313	400	150	153	3560	3111	5481	12153
	<b>Mean</b>	<b>162</b>	<b>164</b>	<b>0</b>	<b>578</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>304</b>	<b>627.3</b>	<b>260</b>	<b>366</b>	<b>154</b>	<b>142</b>	<b>3251</b>	<b>2688</b>	<b>5316</b>	<b>11285</b>
MF	<b>CED</b>	192	0	456	522	211	210	138	276	527.8	246	340	128	0	3248	1102	4943	9294
	<b>Normal</b>	195	0	516	552	288	252	208	309	598.5	288	368	128	0	3703	1196	4857	9756
	<b>Obese</b>	228	0	552	570	288	288	220	324	719.8	306	392	147	0	4035	1339	5822	11197
	<b>Mean</b>	<b>205</b>	<b>0</b>	<b>508</b>	<b>548</b>	<b>262</b>	<b>250</b>	<b>189</b>	<b>303</b>	<b>615.37</b>	<b>280</b>	<b>366</b>	<b>135</b>	<b>0</b>	<b>3662</b>	<b>1218</b>	<b>5207</b>	<b>10081</b>
SF	<b>CED</b>	141	282	297	570	210	222	0	276	487.6	240	344	58.5	135	3263	715	4848	8826
	<b>Normal</b>	156	312	322	600	228	270	0	297	634.4	252	372	67.5	153	3664	1092	5483	10239
	<b>Obese</b>	180	342	357	576	252	294	0	315	672	310	400	76.5	177	3952	1305	5657	10914
	<b>Mean</b>	<b>159</b>	<b>312</b>	<b>325</b>	<b>582</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>296</b>	<b>598</b>	<b>267</b>	<b>372</b>	<b>67.5</b>	<b>155</b>	<b>3626</b>	<b>1032</b>	<b>5329</b>	<b>9997</b>
<b>Mean</b>	<b>175</b>	<b>159</b>	<b>278</b>	<b>569</b>	<b>241</b>	<b>258</b>	<b>63</b>	<b>301</b>	<b>614</b>	<b>269</b>	<b>368</b>	<b>119</b>	<b>99</b>	<b>3513</b>	<b>1646</b>	<b>5284</b>	<b>10449</b>	

\* Represents Total energy expenditure in routine household and dairy activities

TDEE= Energy expenditure from routine activities +Energy expenditure in Sowing + BMR

**Table-27 Data regarding per day total energy expenditure in daily activities during peak agriculture activity- Weeding**

Categories of landholding	Categories of BMI	Energy Expenditure in activities daily performed by the respondents in peak season (Weeding) (in kJ)															BMR (kj/day)	Total EE (kj/day)
		cooking	Washing utensils	Washing clothes	Fetching water	Personal care	Child care	Mopping	Sweeping	Cutting and collecting fodder	Feeding animals	Making dung cake	Milking	Cleaning animal shed	Total *	Weeding		
LAL	CED	138	150	0	558	210	222	0	285	530.1	201	332	150	132	2908	3362	4970	11240
	Normal	178	156	0	600	228	270	0	306	607.7	266	368	162	141	3283	3225	5496	12005
	Obese	171	186	0	576	252	294	0	321	744.2	313	400	150	153	3560	3560	5481	12601
	<b>Mean</b>	<b>162</b>	<b>164</b>	<b>0</b>	<b>578</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>304</b>	<b>627.3</b>	<b>260</b>	<b>366</b>	<b>154</b>	<b>142</b>	<b>3251</b>	<b>3573</b>	<b>5316</b>	<b>11949</b>
MF	CED	192	0	456	522	211	210	138	276	527.8	246	340	128	0	3248	1811	4943	10003
	Normal	195	0	516	552	288	252	208	309	598.5	288	368	128	0	3703	1648	4857	10208
	Obese	228	0	552	570	288	288	220	324	719.8	306	392	147	0	4035	2027	5822	11885
	<b>Mean</b>	<b>205</b>	<b>0</b>	<b>508</b>	<b>548</b>	<b>262</b>	<b>250</b>	<b>189</b>	<b>303</b>	<b>615.3</b>	<b>280</b>	<b>366</b>	<b>135</b>	<b>0</b>	<b>3662</b>	<b>1935</b>	<b>5207</b>	<b>10698</b>
SF	CED	141	282	297	570	210	222	0	276	487.6	240	344	58.5	135	3263	1053	4848	9164
	Normal	156	312	322	600	228	270	0	297	634.4	252	372	67.5	153	3664	1239	5483	10386
	Obese	180	342	357	576	252	294	0	315	672	310	400	76.5	177	3952	1421	5657	11030
	<b>Mean</b>	<b>159</b>	<b>312</b>	<b>325</b>	<b>582</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>296</b>	<b>598</b>	<b>267</b>	<b>372</b>	<b>67.5</b>	<b>155</b>	<b>3626</b>	<b>1251</b>	<b>5329</b>	<b>10193</b>
<b>Mean</b>	<b>175</b>	<b>159</b>	<b>278</b>	<b>569</b>	<b>241</b>	<b>258</b>	<b>63</b>	<b>301</b>	<b>614</b>	<b>269</b>	<b>368</b>	<b>119</b>	<b>99</b>	<b>3513</b>	<b>2253</b>	<b>5284</b>	<b>10947</b>	

\* Represents Total energy expenditure in routine household and dairy activities

TDEE= Energy expenditure from routine activities +Energy expenditure in Harvesting + BMR

Table-28 Data regarding TEED during peak agriculture activity- Harvesting

Categories of landholding	Categories of BMI	Energy Expenditure in activities daily performed by respondents in peak season (Harvesting) (in kJ)														BMR (kJ/day)	Total EE (kJ/day)	
		cooking	Washing utensils	Washing clothes	Fetching water	Personal care	Child care	Mopping	Sweeping	Cutting and collecting fodder	Feeding animals	Making dung cake	Milking	Cleaning animal shed	Total *			Harvesting
LAL	CED	138	150	0	558	210	222	0	285	530.1	201	332	150	132	2908	3995	4970	11873
	Normal	178	156	0	600	228	270	0	306	607.7	266	368	162	141	3283	3984	5496	12764
	Obese	171	186	0	576	252	294	0	321	744.2	313	400	150	153	3560	4150	5481	13191
	Mean	<b>162</b>	<b>164</b>	<b>0</b>	<b>578</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>304</b>	<b>627.3</b>	<b>260</b>	<b>366</b>	<b>154</b>	<b>142</b>	<b>3251</b>	<b>3897</b>	<b>5316</b>	<b>12609</b>
MF	CED	192	0	456	522	211	210	138	276	527.8	246	340	128	0	3248	2940	4943	11132
	Normal	195	0	516	552	288	252	208	309	598.5	288	368	128	0	3703	2892	4857	11453
	Obese	228	0	552	570	288	288	220	324	719.8	306	392	147	0	4035	3796	5822	13653
	Mean	<b>205</b>	<b>0</b>	<b>508</b>	<b>548</b>	<b>262</b>	<b>250</b>	<b>189</b>	<b>303</b>	<b>615.37</b>	<b>280</b>	<b>366</b>	<b>135</b>	<b>0</b>	<b>3662</b>	<b>3123</b>	<b>5207</b>	<b>12079</b>
SF	CED	141	282	297	570	210	222	0	276	487.6	240	344	58.5	135	3263	1260	4848	9371
	Normal	156	312	322	600	228	270	0	297	634.4	252	372	67.5	153	3664	1288	5483	10435
	Obese	180	342	357	576	252	294	0	315	672	310	400	76.5	177	3952	1890	5657	11499
	Mean	<b>159</b>	<b>312</b>	<b>325</b>	<b>582</b>	<b>230</b>	<b>262</b>	<b>0</b>	<b>296</b>	<b>598</b>	<b>267</b>	<b>372</b>	<b>67.5</b>	<b>155</b>	<b>3626</b>	<b>1470</b>	<b>5329</b>	<b>10435</b>
Mean		<b>175</b>	<b>159</b>	<b>278</b>	<b>569</b>	<b>241</b>	<b>258</b>	<b>63</b>	<b>301</b>	<b>614</b>	<b>269</b>	<b>368</b>	<b>119</b>	<b>99</b>	<b>3513</b>	<b>2830</b>	<b>5284</b>	<b>10708</b>

\* Represents Total energy expenditure in routine household and dairy activities

TDEE= Energy expenditure from routine activities +Energy expenditure in Harvesting + BMR

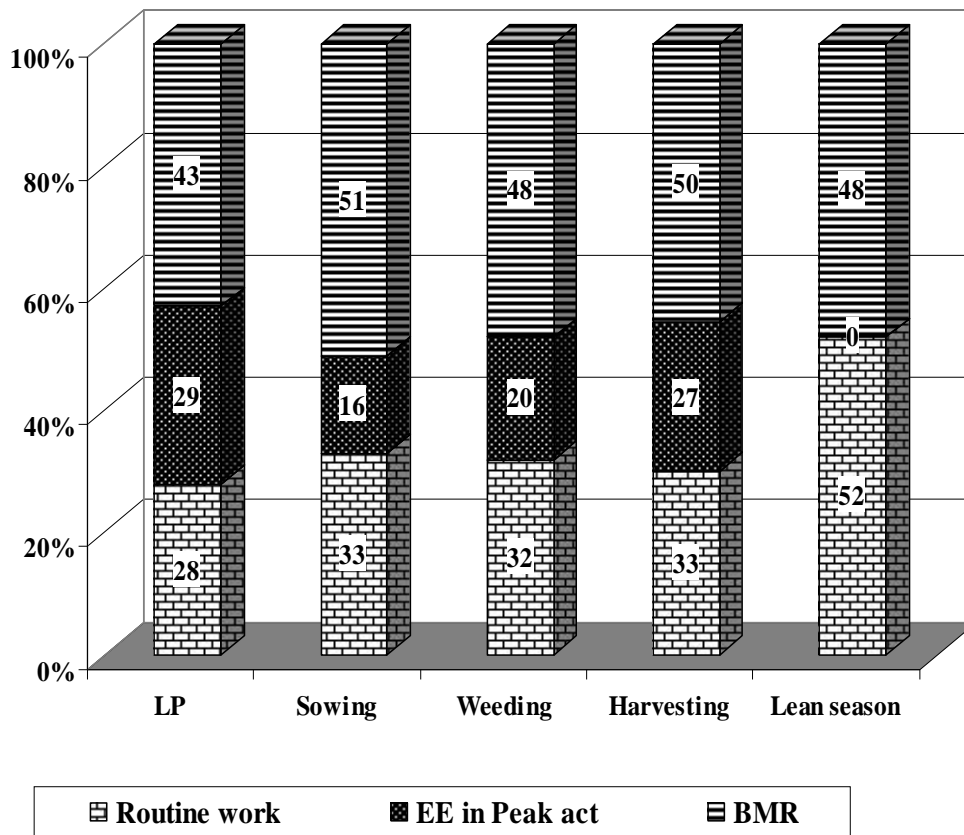
### 4.6.3 Energy Expenditure ratio in lean and peak agriculture season

A glance at Table-29 gives an insight into proportion of Energy Expenditure in various activities during lean and peak season or in difference of physiological workload in lean and peak season. It is evident that 40-50 percent was spent in maintaining Basal Metabolic Rate (BMR) of the body. The energy input by the respondents varied with activity in peak season. The maximum percentage of TDEE was spent in land preparation (29%), followed by Harvesting (29%), than Weeding (20%) and lowest demanding was sowing (16%) but, they do not refrain from routine activity and spend maximum energy (33% of TEED) in it during sowing season. Similarly, a common phenomenon was observed in all seasons that, if the percent energy expenditure was less in peak season activity the corresponding energy percent increased in routine activity. This clearly signifies that about 52-60 percent of TDEE was spent by respondents in daily activities whether it is routine or peak agriculture activity and rest 40-50 percent in BMR (Figure-18). So, it can be concluded that physiological workload in terms of energy expenditure was almost equal in both lean and peak seasons.

**Table-29 Energy expenditure ratio in lean and peak agriculture season**

ENERGY EXPENDITURE	Agricultural Activities (Peak Season)								Lean Season	
	Land Preparation		Sowing		Weeding		Harvesting		kJ/day	%
	kJ/day	%	kJ/day	%	kJ/day	%	kJ/day	%		
<b>Routine Activities</b>	3513	28	3513	33	3513	32	3513	33	5652	52
<b>Peak Activity</b>	3633	29	1646	16	2253	20	2830	27	-	-
<b>BMR</b>	5284	43	5284	51	5284	48	5284	50	5310	48
<b>TDEE</b>	<b>12446</b>	<b>100</b>	<b>10449</b>	<b>100</b>	<b>10947</b>	<b>100</b>	<b>10708</b>	<b>100</b>	<b>10963</b>	<b>100</b>

**Figure -18 Energy Expenditure Ratios in lean and peak agriculture season**



## 4.7. Energy Balance

When energy expenditure is equal to energy intake it is called energy balance whereas, if energy expenditure exceeds energy intake than it shows negative energy balance and if energy expenditure is lower than energy intake than it show positive energy balance.

### 4.7.1. Lean Season

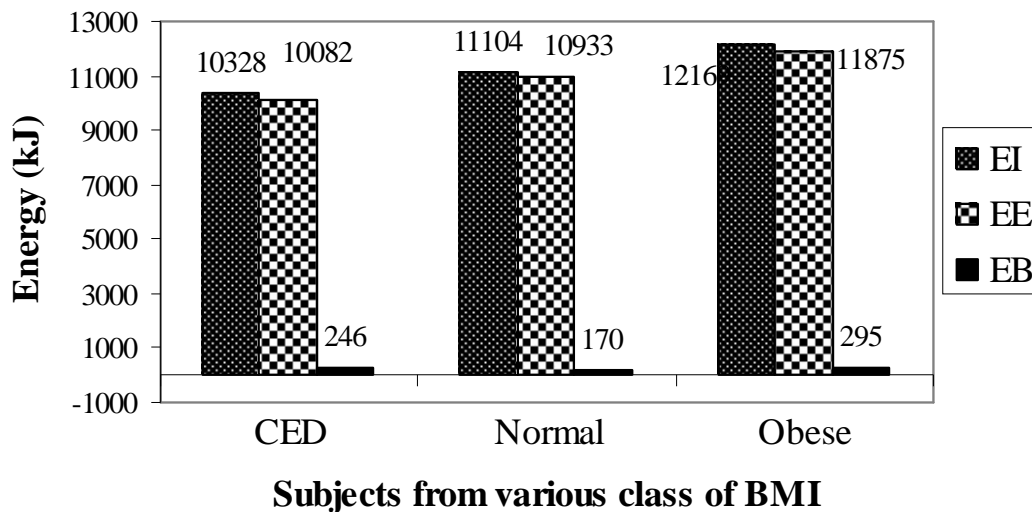
In lean season farmwomen performed routine household and dairy activity means they devote more time to it. Table-30 emphasis the data regarding Energy Intake (EI), Energy Expenditure (EE) and Energy Balance (EB) during lean season. And it is evident from the Table-31 and Figure-19 that all the

subjects, irrespective of landholding and BMI categories had EI more or less exceeding EE thus, representing Positive Energy Balance. The overall mean energy values were 11200 kJ/day, mean energy expenditure being 10963 kJ/day resulting in positive energy balance of 237 kJ/day in lean season.

**Table-30 Energy Intake, Energy Expenditure and Energy Balance data of farmwomen in lean agriculture season**

Categories of landholding	Categories of BMI	Energy intake (kJ/day)	Energy expenditure (kj/day)	Energy balance (kJ/day)
LAL	CED	10369	10188	181
	Normal	11406	11185	221
	Obese	12005	11750	255
	<b>Average</b>	<b>11260</b>	<b>11041</b>	<b>219</b>
MF	CED	10348	10199	149
	Normal	10912	10629	283
	Obese	12623	12339	284
	<b>Average</b>	<b>11294</b>	<b>11056</b>	<b>239</b>
SF	CED	10267	9858	409
	Normal	10993	10986	7
	Obese	11880	11535	345
	<b>Average</b>	<b>11047</b>	<b>10793</b>	<b>254</b>
<b>Mean</b>		<b>11200</b>	<b>10963</b>	<b>237</b>

**Figure-19 Energy Balance in Lean Agriculture Season in various BMI classes**



## 4.8.2. Peak Season

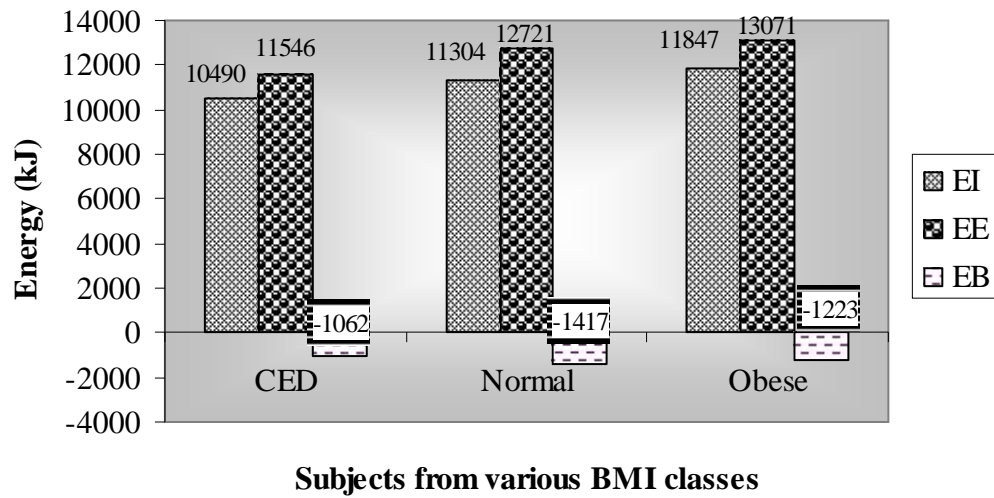
### a. Land Preparation

Data of land preparation in above sections reveals that it is most energy and time demanding activity among peak agricultural activities. And over view of Table-31 and Figure-20 reveals that in all the respondents EE was more than EI thus it showed Negative Energy Balance in all categories of landholding and BMI during land preparation activity. The overall mean EI was 11213 kJ/day with EE of 12446 kJ/day showing a negative balance of 1233 kJ/day

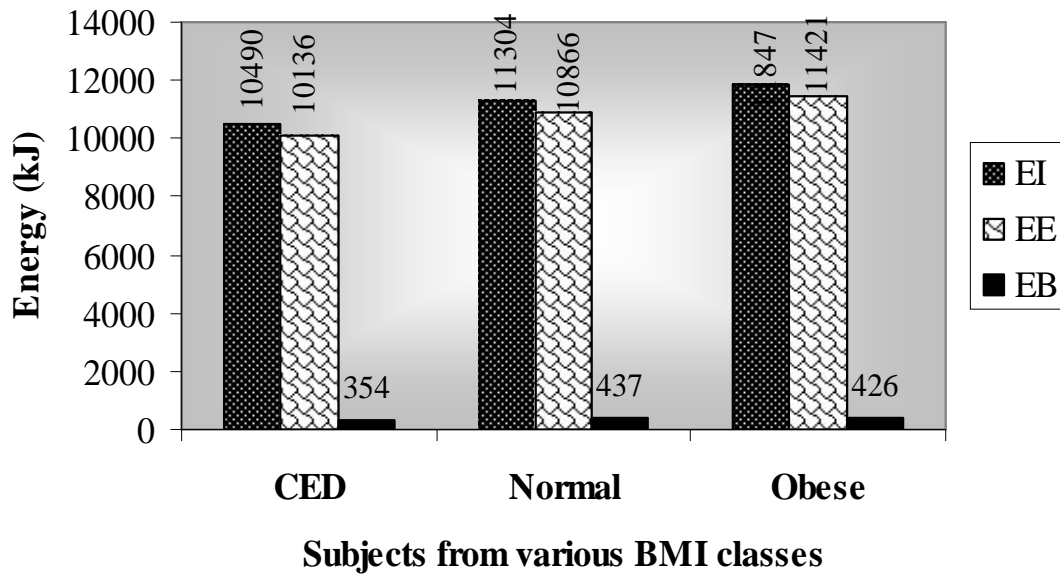
**Table- 31 Energy Intake, Energy Expenditure and Energy Balance data of farmwomen in Peak agriculture activity-Land Preparation**

Categories of landholding	Categories of BMI	Energy intake (kJ/day)	Energy expenditure (kj/day)	Energy balance (kJ/day)
LAL	CED	10626	11839	-1213
	Normal	11914	12963	-1049
	Obese	12083	12771	-688
	Mean	<b>11541</b>	<b>12524</b>	<b>-983</b>
MF	CED	10641	12408	-1767
	Normal	11252	13605	-2353
	Obese	12330	14072	-1742
	Mean	<b>11408</b>	<b>13361</b>	<b>-1954</b>
SF	CED	10202	10392	-190
	Normal	10745	11595	-850
	Obese	11128	12369	-1241
	Mean	<b>10692</b>	<b>11451</b>	<b>-760</b>
Mean		<b>11213</b>	<b>12446</b>	<b>-1233</b>

**Figure-20 Energy Balance in respondents from various BMI class in peak agriculture season-Land Preparation**



**Figure-21 Energy Balance in respondents from various BMI class in peak agriculture season- Sowing**



**b. Sowing**

The discussion of previous section shows that sowing was light activity as compared to other agriculture activities in Peak season and relatively energy expenditure was relatively lower in sowing. The same fact is evident from data in Table-32 and representation in Figure-21 that the entire respondent from all the categories of landholding and BMI class shows Positive Energy Balance except in Obese Class of BMI from LAL. The mean EI was 11213 kJ/day, EE was 10449 kJ with energy balance of 759 kJ/day.

**Table-32 Energy Intake, Energy Expenditure and Energy Balance data of farmwomen in Peak agriculture season (Sowing)**

Categories of landholding	Categories of BMI	Energy intake (kJ/day)	Energy expenditure (kj/day)	Energy balance (kJ/day)
<b>LAL</b>	<b>CED</b>	10626	10318	308
	<b>Normal</b>	11914	11396	518
	<b>Obese</b>	12083	12153	-70
	<b>Mean</b>	<b>11541</b>	<b>11285</b>	<b>252</b>
<b>MF</b>	<b>CED</b>	10641	9294	1347
	<b>Normal</b>	11252	9756	1496
	<b>Obese</b>	12330	11197	1133
	<b>Mean</b>	<b>11408</b>	<b>10081</b>	<b>1325</b>
<b>SF</b>	<b>CED</b>	10202	8826	1377
	<b>Normal</b>	10745	10239	506
	<b>Obese</b>	11128	10914	214
	<b>Mean</b>	<b>10692</b>	<b>9997</b>	<b>699</b>
<b>Mean</b>		<b>11213</b>	<b>10449</b>	<b>759</b>

### c. Weeding

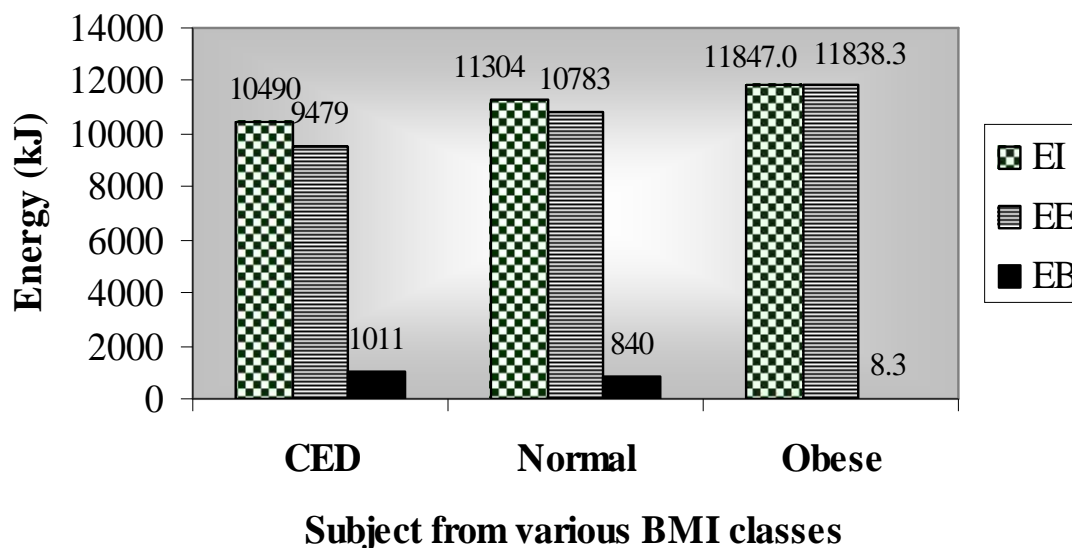
The activity of weeding is solely women's responsibility because it is less mechanized, tedious, repetitive and monotonous activity. And energy expenditure (Table-33 and Figure-22) also demonstrates mixed trends as some respondent showed Positive Balance and others Negative Balance. One fact evident from the table was that all LAL showed Negative Energy Balance, the reason being the same as reported previous section that they worked as hired labourer so they have work for 8 hours and even more in a day beyond

their capacities. The overall mean for EI in weeding was 11213 kJ/day, the EE was 10947 kJ/day resulting marginal positive balance of 267 kJ/day.

**Table-33 Energy Intake, Energy Expenditure and Energy Balance data of farmwomen in Peak agriculture season (Weeding)**

Categories of landholding	Categories of BMI	Energy intake (kJ/day)	Energy expenditure (kJ/day)	Energy balance (kJ/day)
LAL	CED	10626	11240	-614
	Normal	11914	12005	-91
	Obese	12083	12601	-518
	Mean	<b>11541</b>	<b>11949</b>	<b>-408</b>
MF	CED	10641	10003	638
	Normal	11252	10207	1044
	Obese	12330	11885	445
	Mean	<b>11408</b>	<b>10698</b>	<b>709</b>
SF	CED	10202	9164	1038
	Normal	10745	10386	359
	Obese	11128	11029	98
	Mean	<b>10692</b>	<b>10193</b>	<b>498</b>
<b>Mean</b>		<b>11213</b>	<b>10947</b>	<b>267</b>

**Figure-22 Energy Balance in respondents from various BMI classes during Weeding Activity**



**d. Harvesting**

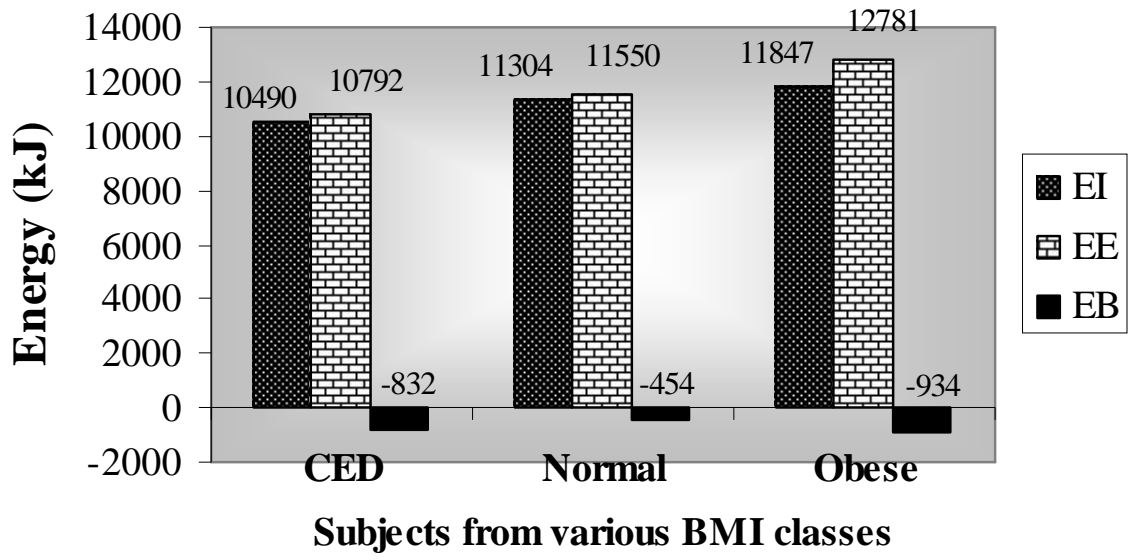
This was also mainly women’s responsibility; but they were assisted by their male counterpart. It is also one of the most

energy and time demanding activity in Peak agriculture activities. This fact was depicted by Table-34 and Figure- 23 that most of the respondents more or less showed Negative Energy Balance and like weeding these were chiefly LAL and also MF irrespective of BMI class. The reason being they devote more time and energy to the activity as compared to respondents from SF category and difference is due to economic status of SF category.

**Table-34 Energy Intake, Energy Expenditure and Energy Balance data of farmwomen in Peak agriculture season (Harvesting)**

Categories of landholding	Categories of BMI	Energy intake (kJ/day)	Energy expenditure (kJ/day)	Energy balance (kJ/day)
<b>LAL</b>	<b>CED</b>	10626	11873	-1247
	<b>Normal</b>	11914	12764	-850
	<b>Obese</b>	12083	13191	-1108
	<b>Mean</b>	<b>11541</b>	<b>12609</b>	<b>-1068</b>
<b>MF</b>	<b>CED</b>	10641	11132	-491
	<b>Normal</b>	11252	11452	-201
	<b>Obese</b>	12330	13653	-1323
	<b>Mean</b>	<b>11408</b>	<b>12059</b>	<b>-672</b>
<b>SF</b>	<b>CED</b>	10202	9371	831
	<b>Normal</b>	10745	10435	310
	<b>Obese</b>	11128	11499	-371
	<b>Mean</b>	<b>10692</b>	<b>10435</b>	<b>257</b>
<b>Mean</b>		<b>11213</b>	<b>10708</b>	<b>-494</b>

**Figure- 23 Energy Balance in respondents from various BMI classes during Harvesting Activity**



**Table-35 Data regarding Energy Intake, Energy Expenditure, Energy Balance and percent difference in EI and EE in various BMI classes**

Season		BMI class	Energy Intake	Energy Expenditure	Energy Balance	Percentage Difference
<b>Lean Season</b>		<b>CED</b>	10328	10082	246	2.3
		<b>Normal</b>	11104	10933	170	1.5
		<b>Obese</b>	12169	11875	295	2.4
<b>Peak Season</b>	<b>Land Preparation</b>	<b>CED</b>	10490	11546	-1057	-10.1
		<b>Normal</b>	11304	12721	-1417	-12.5
		<b>Obese</b>	11847	13071	-1224	-10.3
	<b>Sowing</b>	<b>CED</b>	10490	9479	1010	9.6
		<b>Normal</b>	11304	10783	521	4.6
		<b>Obese</b>	11848	11421	426	3.6
	<b>Weeding</b>	<b>CED</b>	10490	10136	354	3.4
		<b>Normal</b>	11304	10866	438	3.9
		<b>Obese</b>	11848	11838	9	0.07
	<b>Harvesting</b>	<b>CED</b>	10490	10792	-302	-.2.8
		<b>Normal</b>	11304	11550	-247	-2.1
		<b>Obese</b>	11848	12781	-934	-7.8

When energy expenditure is equal to energy intake it is called energy balance whereas, if energy expenditure exceeds energy intake than it shows negative energy balance and if energy expenditure is lower than energy intake than it shows positive energy balance. Energy balance was positive during lean season irrespective of BMI class. In Peak season Energy balance was positive during sowing and weeding, and balance was negative during land preparation and harvesting (Table-35).

These results are in close conformity with the findings of Choudhary and Jain (1997) who also reported energy intake less than energy expenditure in farm women. In the study group of Dungarwal (1999) the mean energy intake was 2085 Kcal and showed a negative balance of 378 Kcal. Gazman et. al. (1998) also found in male and female leguna rice farmers a low energy intake in comparison to their expenditure. Similarly, negative balance has

been reported by Norgan et. al. (1974), Bleiberg et. al. and Edmundson and Edmundson (1988).

Therefore, it can be said that the homeostatic mechanism which controls and regulates energy balance involves a complex and long term lag mechanism; it is true for the farmwomen of the present study. Obesity is associated with age, education, and reproductive factors in women. Obesity represents a more complex entity where psychological and genetic factors that are difficult to assess may be more important.

## **4.8. Physiological Work Load of the subjects**

### **4.8.1. Maximum Heart Rate and Aerobic Capacity of the Subjects**

The Sub-maximal experiment was conducted in a controlled environment in a laboratory on computerized tread mill. The observed data of heart rate and oxygen uptake at all speeds and slope for all categories of BMI is presented in Appendix-IV. The data shows that with increasing grade heart rate (HR) and oxygen consumption rate (OCR) also increased in linear fashion in all categories of BMI. The linear relationship of HR and OCR in all the three categories of BMI viz. CED, Normal and Obese, is presented in Figure-24, 25 and 26.

The data presented in Appendix-V was plotted on graph for extrapolation of oxygen uptake ( $VO_2$  max/ aerobic capacity) at maximal heart rate (MHR). After determining the aerobic capacity of each worker, it was divided by their body weight and aerobic capacity in ml/kg-body mass/min was estimated and presented in Table-36.

The maximal heart rate (MHR), maximum oxygen consumption rate ( $VO_2$  max) is given in the Table-36. The MHR was  $185.14 \pm 2.25$  beats/min in subjects of CED,  $184.45 \pm 2.2$  in Normal category and  $180.80 \pm 2.46$  beats/min in subjects of Obese category. The aerobic capacity ( $VO_2$  max) was  $1.11 \pm 0.32$  l/min ( $26.4 \pm 7.43$  ml/kg/min) in subjects of CED class of BMI,  $1.25 \pm 0.03$  l/min ( $24.071 \pm 2.24$

ml/kg/min) in subjects of Normal BMI class and  $1.07 \pm 0.12$  l/min ( $16.480 \pm 2.85$  ml/kg/min) in subjects of Obese category.

Table-36 MHR and VO<sub>2</sub> max of each respondent from various BMI class.

BMI Class	Subjects	MHR* (Beats/min)	VO <sub>2</sub> max of the respondents	
			l/min	ml/kg-body mass /min
Chronic Energy Deficient	S1	186	1.04	24.19
	S2	186	1.8	42.86
	S3	184	0.92	21.90
	S4	187	0.87	21.75
	S5	181	1.1	25.00
	S6	183	0.92	23.00
	Mean	<b>185±2.25</b>	<b>1.11±0.32</b>	<b>26.4±7.43</b>
Normal	S7	181	1.23	21.96
	S8	185	1.21	22.83
	S9	187	1.295	28.15
	S10	183	1.239	25.81
	S11	181	1.23	21.96
	S12	185	1.28	23.70
	Mean	<b>184±2.2</b>	<b>1.25±0.03</b>	<b>24.071±2.24</b>
Obese	S13	181	1.04	15.52
	S14	185	1.15	19.17

S15	179	1.1	16.92
S16	178	0.92	12.96
S17	179	0.93	13.48
S18	180	1.25	20.83
<b>Mean</b>	<b>180±2.46</b>	<b>1.07±0.12</b>	<b>16.480±2.85</b>

\* as per Robergs and Landwehr (2002)

Figure-24 Relationship of OCR and HR in CED class of BMI

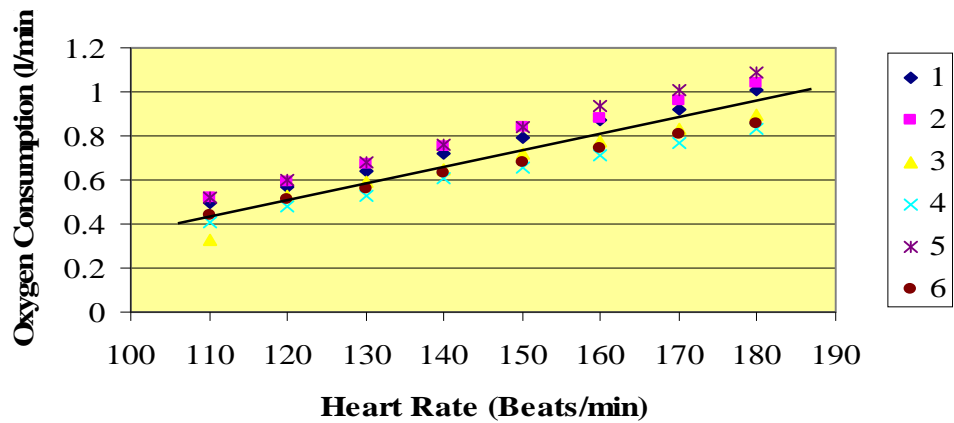


Figure-25 Relationship of OCR and HR in Normal class of BMI

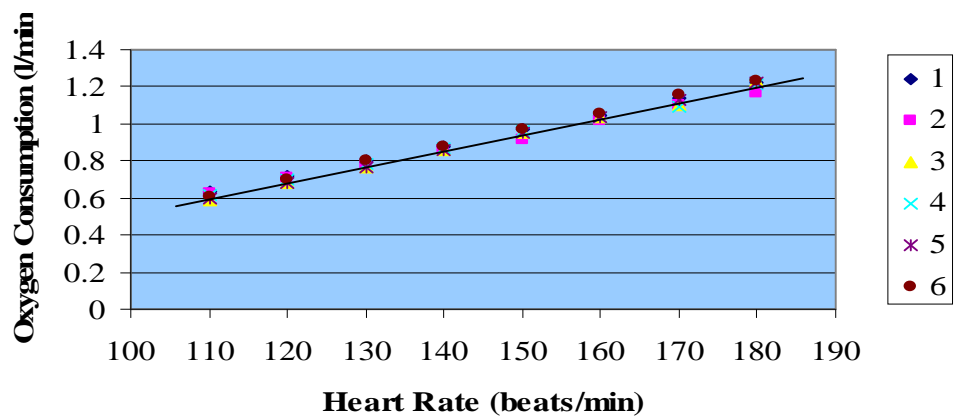
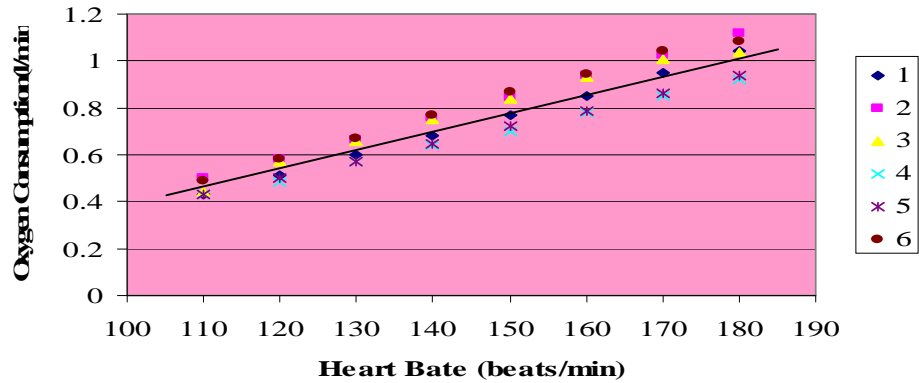


Figure-26 Relationship of OCR and HR in Obese class of BMI



#### 4.8.2. Relationship between Physiological workload and Nutritional Profile of the Subjects

The data regarding mean  $\pm$  standard deviation and difference between categories of BMI for age, weight, protein intake, iron intake, energy intake and haemoglobin level of respondents from all categories of BMI is presented in Appendix-V. And relationship of Physiological workload (MHR,  $VO_2$  max and exercise time) and Nutritional status is presented in Table-37 given below:

**Table-37 Relationship of MHR, Exercise time (ET) and Aerobic Capacity ( $VO_2$  max) with age and nutritional profile in various BMI class.**

Particulars	BMI Class								
	CED			Normal			Obese		
	MH R	$VO_2$ max	ET	MH R	$VO_2$ max	ET	MH R	$VO_2$ max	ET
Age	-1**	-.44	-.55	-1**	-.58	-.64	-1**	-.52	-.43
Weight	.49	.27	.66	.72	-.52	-.72*	-.71	-.9**	-.61*

					4		9		
<b>Protein</b>	.16	.38	.56	.02	.40	.87*	.53	.38	.45
	1	4		4	0		6	1	
<b>Iron</b>	.58	.02	.65	.21	.31	.34	.66	.44	.54
	3	0		0	1		2	6	
<b>Haemoglobin</b>	.64	.28	.87*	.10	.29	.65	.84	.37	.66
	5	6		1	1		6*	5	
<b>Energy Intake</b>	.53	.61	.36	.23	.74	.78*	.38	.16	.46
	2	5		8	8	*	8	8	

\* Correlation is significant at the 0.01 level (2-tailed)

\*\* Correlation is significant at the 0.05 level (2-tailed)

#### a. Age

Maximum heart rate (MHR), aerobic capacity (VO<sub>2</sub> max) and exercise time decreased with increase in age in all the respondents from all BMI class.

#### b. Weight

MHR, VO<sub>2</sub> max and exercise time increased with weight in CED, whereas decreased with increase in weight in Obese.

#### c. Protein Intake

Maximum heart rate, aerobic capacity and exercise time increased with increase in intake of protein in all respondents of all BMI classes.

#### d. Iron Intake

Maximum heart rate, aerobic capacity and exercise time increased with increase in intake of iron in all respondents of all BMI class.

#### e. Haemoglobin level

And the same trend is emphasized in Haemoglobin level that means as haemoglobin level raised MHR, VO<sub>2</sub> max and exercise

time also rose in same manner in all categories of BMI (Body Mass Index). The results are supported by the findings of Malville (1991) who reported that haemoglobin concentration of 71 women living in rural areas of Kathmandu in Nepal was correlated with higher MHR and oxygen uptake capacity and mechanical efficiency during sub-maximal aerobic exercise.

#### **f. Energy intake**

We need energy for different activities which our body is constantly performing. Apart from activities like standing and walking energy is spent even while sleeping, breathing and digesting food also requires energy. In addition to these basic activities the farmwomen has to perform in fields. Unless one has adequate energy the person cannot show efficiency in work. MHR,  $VO_2$  max and exercise time was positively correlated with energy intake as intake increased MHR,  $VO_2$  max and exercise time increased.

Rao (1999) also reported that work output may be affected by low energy intake and nutritional status of individual. When energy intake is low there is a possible behavioural adaptation to adjust work output to match energy intake.

In study on group of young Colombian adults (Spurr, 2005) who were described as having CED of varying degrees of severity were studied, the result shows that only the severely malnourished group (the group with mean BMI < 18.5) had a marked reduction in  $VO_2$  max, expressed in total liters of oxygen per minute.

Detailed Studies of migrant labourers in Brazil have shown an association of poor nutritional status, identified from anthropometry, with lowered work capacity (Desai, 1989). Similar data were emerging from India, where good correlation were found between body weight, BMI, work capacity in undernourished individuals in Hyderabad (Satayanarayan et. al, 1989). In the Indian study, it has shown that their total work capacity reduced with low BMI status. Zha and Hass (1997) in a study on relation between iron

deficiency without anemia and physical performance showed that iron depleted group had a significantly lower VO<sub>2</sub> max.

Physical work capacity is defined as the ability to perform physical work load. So, in nut shell it can be concluded from the Table-37 and review of studies that as nutritional status, BMI improves, physical work capacity also increases means capacity to bear Physiological workload increases. Thereby, person gets less fatigued and productivity is also enhanced. Whereas, with increasing age and weight of a person, capacity to do work decreases.

### 4.8.3. Regression equation

For calculation of regression equation, for all BMI Class and a general equation, oxygen uptake at heart rate of 110, 120, 130, 140, 150, 160, 170, 180 beats/min for all BMI categories was estimated and was plotted separately. Following equations were suggested for calculating oxygen consumption (y) at their known heart rate (x) during various agriculture operations.

<b>y = 0.007 x - 0.301</b>	<b>for</b>
<b>CED</b>	
<b>y = 0.0081 x - 0.271</b>	<b>for</b>
<b>Normal</b>	
<b>y = 0.0069 x - 0.251</b>	<b>for</b>
<b>Obese</b>	
<b>y = 0.0086 x - 0.469</b>	<b>for</b>
<b>General</b>	

**Table-38 Significant Difference between Estimated and Calculated VO<sub>2</sub> (l/min)**

Subjects	BMI Class (t-values)					
	CED	Normal	Obese	General		
				CED	Normal	Obese
S1	0.43 NS	0.33 NS	0.88 NS	0.96 NS	1.52 NS	1.89 NS

<b>S2</b>	0.86 NS	0.73 NS	.028 NS	0.64 NS	1.34 NS	0.45 NS
<b>S3</b>	0.93 NS	0.45 NS	0.67 NS	0.84 NS	0.39 NS	0.86 NS
<b>S4</b>	3.03*	0.54 NS	0.64 NS	2.56 *	0.94 NS	0.97 NS
<b>S5</b>	0.89 NS	1.65 NS	0.43 NS	0.76 NS	0.87 NS	0.46 NS
<b>S6</b>	0.369 NS	0.47 NS	0.55 NS	0.44 NS	0.65 NS	0.65 NS

NS= Non Significant

\*Significant at 0.01 level

The difference in estimated and calculated oxygen consumption was estimated and is given in Table-38 and it shows that there was non-significant difference in estimated and calculated oxygen consumption from regression equation at increasing heart rate (110-180 beats/min).

## **Conclusion:**

From the foregoing review of literature it can be deduced that women farmers toil in hard labour in agricultural activities around the globe. This fact is substantiated by results of various research studies indicating heavy physiological cost of agricultural activities in terms of heart rate, Energy Expenditure and  $VO_2$  max data. Many studies have shown that this heavy workload is further aggravated by increased incidence of health hazards in agriculture due to working conditions and environment. The results of studies also put forth the fact that the nutritional status of farm women is also poor to meet the heavy workload demands of energy in agricultural works.

The review explicitly confirm that very scanty work has been done especially in India to find out energy intake and energy output of women during lean and peak agricultural seasons. Moreover no data is available which studies energy expenditure in terms of cardiac cost and physiological cost of work in relation to food or nutrient intake.

Thus, the present research endeavor to study energy intake in terms of nutrients and EE in various agricultural and home activities in terms of physiological cost in lean and peak agricultural seasons. The research will also establish relation between nutritional status and incidence of occupational health hazards in agriculture.

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