RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

The results of the investigation obtained through analysis of data are presented in this chapter. The entire descriptive analysis was done on the basis of size of land holding for meaningful presentation. Thus the whole sample was divided into four groups i.e. Marginal farmers having less than one acre land, small farmers having 1.0 – 2.0 acre land, medium farmers having 2.1 – 4.0 acres land and large farmers having greater than 4.0 acres land.

Findings of the study are introduced through composite frequency and percentage tables followed by the statistical applications for the testing of hypotheses and relevant discussion pertaining to various objectives of the investigation. Results and discussion of the investigation are described under the following sections.

4.1 Demographic Characteristics of Women Farmers

4.2 Agriculture and Livestock Related Data

4.3 Attitude of Women Farmers Regarding Organic Farming

4.4 Critical Activities Performed by Women Farmers

4.5 Body Discomfort Experienced by Women Farmers

4.6 Experimental Data

4.7 Testing of Hypotheses

4.8 Discussion of Findings

SECTION I

4.1 Demographic Characteristics of Women Farmers

This section of the study deals with the description of the information on personal, family and situational characteristics of women farmers. Women farmers involved in organic farming were the key respondents for the investigation along with supportive information from other family members.

4.1.1 Personal Characteristics of Women Farmers

Age, educational level and occupation of farmers comprised the personal characteristics of women farmers (**Table 4.1**)

Age

The mean age of women farmers was 36.74 ± 1.10 years. Age of the women farmers ranged from 16 to above 50 years. Out of whole sample 44.17 per cent of women farmers belonged to the age group of 16- 35 years which was classified as younger age group and 19.16 per cent of them belonged to the age group 50 and above years classified as older age group. Remaining 36.67 per cent of women farmers were from age group of 36 - 49 years classified as middle age group. There was not much difference in age of respondents based on size of land holding.

Educational level

On the whole 19.17 per cent of women farmers were illiterate, very few of them i.e. 6.66 per cent were postgraduate. Rest of them varied in their educational level. Among the marginal women farmers 47.06 per cent were illiterate and very few of them i.e. 11.77 per cent had education upto intermediate level. None of them were graduate and postgraduate. On the other hand among the large women farmers none of them were illiterate and 17.40 per cent were postgraduate. Slight variation was found among small and medium farmers regarding education. The overall data on education level of women farmers showed a positive trend towards education.

Table 4.1 : Personal Characteristics of Women Farmers

Personal Characteristics	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Age (years)										
Younger group (16-35)	08	47.06	18	38.29	16	48.48	11	47.83	53	44.17
Middle group (36 - 49)	08	47.06	19	40 43	08	24.25	09	39.13	44	36.67
Older group (50 & above)	01	5.88	10	21 28	09	27.27	03	13.04	23	19 16
Mean age		35.58		37 97		38.58		35.83		36.74
S.E		±2.41		±1.59		±2 63		±2.33		±1.10
Educational level										
Illiterate	08	47.06	11	23.41	04	12.12	-	-	23	19 17
Can read & write	-	-	02	4.26	-	-	-	-	02	01 67
Primary	05	29 41	10	21 27	07	21.21	03	13.04	25	20.83
Middle	01	5.88	10	21 27	07	21.21	03	13.04	21	17.50
Matric	01	5.88	03	6.38	04	12.12	06	26.08	14	11.67
Intermediate	02	11.77	05	10.64	05	15.16	04	17.40	16	13 33
Graduate	-	-	05	10 64	03	9 09	03	13 04	11	09.17
Post graduate	-	-	01	2 13	03	9.09	04	17 40	08	6 66
Occupation of farmer										
Full time farmer	15	88.24	44	93.62	28	84.84	19	82 61	106	88 33
Part time farmer	02	11.76	03	6.38	05	15.16	04	17.39	14	11 67

Occupation of farmer

On the whole majority of women farmers i.e. 88.33 per cent were full time farmers and very few of them i.e. 11.67 per cent were part time farmer. There was not much variation in occupation of farmers based on size of land holding.

4.1.2 Family Characteristics of Women Farmers

Type of family, family size, size of land holding and total monthly income of family from all sources have been analysed as the family characteristics of women farmers (**Table 4.2**).

Type of family

It was observed that more than half i.e. 55.83 per cent of women farmers belonged to nuclear family and 44.17 per cent of them belonged to joint family. Among the marginal women farmers more than half i.e. 58.83 per cent belonged to joint family and 41.17 per cent of them belonged to nuclear family. Among the small and medium women farmers majority of them (70.22 per cent and 54.55 per cent respectively) belonged to nuclear family while among the large women farmers majority of them i.e. 60.87 per cent belonged to joint family.

Thus joint family system was prominent among marginal and large women farmers and nuclear family system was prominent among small and medium women farmers.

Family size

The mean family size of the women farmer was 7.01 ± 0.31 members. The range of the size of the family was less than 5 to greater than 10 members. Most of the women farmers i.e. 58.33 per cent in the total sample had the family size of 5 to 10 members (medium family size) and 20.00 per cent of them belonged to family having less than five members (small family size) only 21.67 per cent of women farmers in the total sample had a family size of more than 10 members (large family). Women farmers of marginal (64.70 per cent), small (61.71 per cent) and medium (60.60 per cent) families had medium

Table 4.2 : Family Characteristics of the Women Farmers

Family Characteristics	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Type of family										
Nuclear	07	41.17	33	70.22	18	54.55	09	39 13	67	55.83
Joint	10	58.83	14	29.78	15	45.45	14	60.87	53	44.17
Family size (Members)										
Small (< 5)	2	11.77	14	29.78	05	15.16	03	13.04	24	20.00
Medium (5 – 10)	11	64.70	29	61.71	20	60.60	10	43.48	70	58 33
Large (>10)	04	23 53	04	8.51	08	24.24	10	43.48	26	21 67
Mean		7 64		5.95		7.21		8 78		7.0
S E		±0.75		±0.29		±0.71		±0 87		±0 31
Size of land holding (acres)										
Marginal (< 1 0)	17	100 00	-	-	-	-	-	-	17	14 16
Small (1.0– 2.0)	-	-	47	100.00	-	-	-	-	17	14 16
Medium (2.1 - 4.0)	-	-	-	-	33	100 00	-	-	33	27 50
Large (> 4.0)	-	-	-	-	-	-	23	100 00	23	19 17
Mean		0.41		1.46		3 0		7 60		2.90
S.E		±0.80		±0 56		±0.84		±0 84		±0 27
Total monthly income of family from all sources (Rs.)										
Low income (up to 1700)	17	100 00	15	25 53	-	-	-	-	29	24 17
Middle income (1701 - 4200)	-	-	35	74.46	18	54.55	-	-	53	44 17
Large income (4201 - 8400)	-	-	-	-	15	45 45	23	100 00	38	31 67
Mean		1158.82		3046 80		4342 42		6869.57		3870.00
S.E		±80 06		±155.66		±338.03		±554 33		±221 47

family of 5 to 10 members while the large women farmers (43.48 per cent) had large family size of more than 10 members. On the whole, the data showed a trend towards medium family.

Size of land holding

The mean size of land holding of women farmers was 2.90 ± 0.27 acres. Size of land holding ranged from less than one acre to more than four acres of land. On the whole 19.17 per cent of women farmers had large size of land holding i.e. greater than 4 acres and 14.16 per cent of them had marginal land holding i.e. less than one acre. Remaining 39.17 per cent of them had small (1.0 – 2.0 acres) and 27.50 per cent of them had medium size of land holding i.e. 2.1 – 4.0 acres.

Total monthly income of family from all sources

Mean monthly income of family was Rs. 3870 ± 221.47. Monthly income of family ranged from Rs.1700 to Rs.8400. On the whole less than half of them i.e. 44.17 per cent of women farmers had medium income of Rs.1701 to Rs.4200 while 24.17 per cent of them had low income of Rs.1700. Remaining 31.67 per cent of them had large income of Rs.4201 to Rs.8400. All the marginal women farmers had low income i.e. upto Rs.1700.

Among small women farmers majority of them i.e. 74.46 per cent had medium income of Rs.1701 to Rs.4200 and about one fourth of them i.e. 25.53 per cent had low income. Among medium women farmers more than half i.e. 54.55 per cent had middle income and 45.45 per cent of them had large income. All the large women farmers had large income i.e. Rs.4201 to 8400. Thus on the basis of size of land holding greater difference was observed in income of farmers.

4.1.3 Situational Characteristics of Women Farmers

Situational characteristics included farming practices, years of experience in organic farming and mode of production of crops. (**Table 4.3**)

Table 4.3 : Situational Characteristics of Women Farmers

Situational Characteristics	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Farming practices										
Self farming	13	76.47	46	97.87	32	96.97	23	100 00	114	95.00
Tenant farming	04	23 53	01	2 13	01	3.03	00	0 00	06	5 00
Years of experience in organic farming										
< 16	11	64.71	30	63.83	22	66.67	18	78 26	81	67 50
16 - 33	05	29.41	11	23 40	08	24.24	04	17.39	28	23.33
34 - 50	01	5.88	06	12.77	03	9.09	01	4.35	11	9.17
Mean		13.23		12 69		12 15		8 76		11 85
SE		±2.54		±2 08		±2.43		±2 49		±1 20
Mode of production of crop										
Seasonal	15	88.24	39	82 98	25	75 26	22	95.65	101	84 17
Half yearly	02	11.76	08	17 02	08	24 21	01	4 35	19	15 83
Annually	-	-	-	-	-	-	-	-	-	-

Farming practices

On the whole 95.00 per cent of women farmers were self farmers and very few of them i.e. only 5.00 per cent were tenants farmers. Among marginal farmers about less than one fourth i.e. 23.53 per cent of them were tenant farmers. Least variation was observed on the basis of size of land holding.

Years of experience in organic farming

Mean years of experience in organic farming was 11 85 ± 1.12 years. Years of experience in organic farming ranged from less than 16 to 50 years It was

observed that more than half i.e. 67.50 per cent of women farmers had less than 16 years of experience in organic farming and very few of them i.e. 9.17 per cent had 34–50 years of experience in organic farming. Remaining less than one fourth i.e. 23.33 per cent of them had 16 to 33 years of experience in organic farming. There was not much difference in years of experience regarding organic farming among women farmers on the basis of size of land holding.

Mode of production of crops

On the whole majority of women farmers i.e. 84.17 per cent of them were producing crops seasonally only 15.83 per cent of them producing half yearly. None of them were producing annually. Similar pattern was observed among all levels of farmers.

SECTION II

Agriculture and Livestock Related Data

This section deals with the agriculture and livestock related data of women farmers involved in organic farming.

4.2.1 Livestock Profile of Women Farmers

Data reported in **Table 4.4** presents the live stock profile of women farmers.

Table 4.4 : Livestock Profile of Women Farmers

Live Stock Profile	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Type of live stock										
Cow	03	17.65	17	36.17	08	24.24	04	17 39	32	26.67
Buffalo	03	17.65	03	6 38	01	3.03	-	-	07	5 83
Both	09	52.94	26	55 32	23	69.70	16	69.57	74	61 67
None	02	11.76	01	2 13	01	3.03	03	13.04	07	5.83
Average herd size										
Cow	2 41		2 48		3.88		4 91		3.33	
Buffalo	1.17		1.17		1 37		1 43		1.28	
Number of livestock										
< 6	15	88 24	40	85.11	23	69.70	15	65.22	93	77.50
6 – 10	02	11 76	06	12 76	10	30.30	07	30 43	25	20.83
> 10	-	-	01	2 13	-	-	01	4 35	02	1.67
Mean		3.58		4 93		5 24		6.70		5 20
S E		±0 61		±0.41		±0.46		±0.97		±0 29

Type of livestock

On the whole more than half i.e. 61.67 per cent of women farmers possessed both cows and buffaloes and very few of them i.e. 5.83 per cent had neither cow nor buffaloes. Least difference was observed among women farmers on the basis of size of land holding.

Average herd size

With regard to average herd size, on the whole cow stood first i.e. 3.33 cow per farmer followed by buffaloes i.e. 1.28 per farmer. Similar pattern was observed among all the farmers of different size of land holdings.

Number of livestock

Mean number of livestock was 5.20 ± 0.29. Number of livestock ranged from less than 6 to more than 10. Majority of women farmers i.e. 77.50 per cent had less than 6 number of livestock and only 1.67 per cent had above 10 number of livestock. Remaining 20.83 per cent had 6 to 10 number of livestock. Among marginal and medium farmers none of them had large number of live stock i.e. above 10 and only 2.13 per cent of small farmers and 4.35 per cent of large farmers had large number of livestock.

4.2.2 Information on Organic Manure and its Application

Information on organic manure and its application is presented in **Table 4. 5**

Source of manure

On the whole about 50.83 per cent of women farmers used self made manure and very few of them i.e. only 2.50 per cent used only market manure. Remaining 46.67 per cent of them used both self-made and market manure. On the basis of size of land holding only 5 88 per cent of marginal farmers and 8 70 per cent of large marginal farmers used only market manure Rest of them used both self made and market manure.

Table 4.5 : Information on Organic Manure and its Application

Organic Manure	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Source of manure										
Self made	05	29.41	29	61 70	18	54.55	09	39.13	61	50 83
Market	01	5.88	-	-	--	-	02	8.70	03	2.50
Both	11	64.71	18	38 30	15	45 45	12	52.17	56	46.67
Frequency of application (per month)										
Once	09	52 94	23	48.94	14	42.42	09	39 13	55	45 83
Twice	06	35.30	22	46.80	19	57 58	14	60.87	61	50 84
Many times	02	11.76	02	4.26	-	-	-	-	04	3 33
Place of storage										
Tank	-	-	08	17.02	03	9 09	08	34.78	19	15 83
Heap	17	100.00	39	82 98	30	90 91	15	65 22	101	84 17

Frequency of application

It was found that about 50.84 per cent of women farmers applied manure twice per month and very few of them i.e. 3.33 per cent applied many times. Remaining less than half i.e. 45.83 per cent of them applied once a month. On the basis of size of land holding 11.76 per cent of marginal farmers and 4.26 per cent of small farmers applied manure many times per month. None of the medium and large farmer applied manure many times per month.

Place of storage

On the whole majority of women farmers i.e. 84.17 per cent stored manure in the form of heap and very few of them i.e. 15.83 per cent used tank for storage of manure. All the marginal women farmers stored manure in the form of heap. Other group of farmers also used tank for storage of manure.

4.2.3 Information on Bio-pesticides and its Application

Information on bio-pesticides and its application is presented in **Table 4.6**

Sources of getting bio-pesticides

All the women farmers belonged to different groups were getting bio-pesticides from authorised / certified bio-pesticides agencies. None of them purchased bio-pesticides from unauthorised shop.

Selection of bio-pesticides

It was found that more than half i.e. 51.67 per cent women farmers were selecting bio-pesticides on the basis of disease and only 5.83 per cent of them used on the basis of availability. Remaining 42.50 per cent of them selected bio-pesticides on the basis of crop. None of the marginal farmer select bio-pesticide on the basis of availability. Very few small, medium and large farmers selected bio-pesticides on the basis of availability.

Period of using pesticides

It was noted that more than half i.e. 53.33 per cent of women farmers used pesticides when a disease attacked and 46.67 per cent of them used before flowering. On the basis of size of land holding majority of marginal (70.59 per cent) and large farmers (60.87 per cent) used pesticides when a disease attacked while more than half i.e. 53.20 per cent of small farmers and 51 52 per cent of medium farmers used pesticides before flowering.

Frequency of application

On the whole more than half i.e. 56.67 per cent women farmers applied pesticides once a month and only 15.00 per cent of them applied many times during the month. Remaining 28.33 per cent of them applied two times per month. On the basis of size of land holding least differences were observed among them.

Table 4.6 : Information on Pesticide and its Application

Pesticides	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Sources of getting bio-pesticides										
Authorized / certified	17	100.00	47	100.00	33	100.00	23	100.00	120	100.00
Bio-pesticides agency	-	-	-	-	-	-	-	-	-	-
Unauthorized shop	-	-	-	-	-	-	-	-	-	-
Selection of bio-pesticides										
Based on crop	06	35 29	19	40 43	15	45.46	11	47.83	51	42 50
Based on disease	11	64.71	25	53.19	15	45.45	11	47.83	62	51.67
Based on the availability	-	-	03	6.38	03	9.09	01	4.35	07	5.83
Period of using pesticides										
When a disease attack	12	70 59	22	46.80	16	48.48	14	60.87	64	53 33
Before flowering	05	29.41	25	53.20	17	51.52	09	39 13	56	46 67
Any time	-		-		-		-		-	
Frequency of application (per month)										
One Time	12	70 59	29	61 70	17	51.52	10	43 48	68	56 67
Two times	-	-	12	25 53	14	42.42	08	34.78	34	28 33
May times	05	29 41	06	12 77	02	6.06	05	2174	18	15.00
Knowledge about waiting period of bio-pesticides										
Yes	03	17.65	29	61.70	19	57.58	13	56.52	64	53 33
No	14	82 36	18	38 30	14	42 42	10	38.48	56	46.67

Knowledge about waiting period of bio-pesticides

It was found that more than half i.e. 53.33 per cent of women farmers had knowledge about waiting period of bio-pesticides and 46.67 per cent of them were not having knowledge about waiting period of bio-pesticides. Among the marginal women farmers majority of them i.e. 82.36 per cent had no knowledge regarding waiting period of bio-pesticides, while among small, medium and large farmers more than half of them were having knowledge regarding waiting period of pesticides.

4.2.4 Awareness of Women Farmers Regarding Pesticides Resistance

Awareness regarding pesticides resistance in pest and pesticides residue in food and their hazards were analysed and reported in **Table 4.7.**

Table 4.7 : Awareness of Farmers Regarding Pesticides Resistance

Awareness	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Pesticides resistance in pest										
Aware	03	17 64	17	36.17	16	48.48	12	52.17	48	40 00
Not aware	14	82.36	30	63.83	17	51 52	11	47.83	72	60.00
Pesticides residue in food & their hazards										
Aware	05	29 41	33	70.21	22	66 67	15	65 22	75	62 50
Not aware	12	70 59	14	29.79	11	33 33	08	34 78	45	37 50

Pesticides resistance in pest

It was observed that majority of women farmers i.e. 60.00 per cent of them were not aware about pesticides resistance in pest only 40.00 per cent of them were aware about it. Among marginal women farmers majority them i.e 82.36 per cent were aware about it On the other hand among large women farmers more than half i.e 52.17 per cent were aware about pesticides resistance in

pest. Among the remaining small and medium farmers more than half of them were not aware about it.

Pesticides residue in food and their hazards

On the whole more than half i.e. 62.50 per cent of women farmers were aware about pesticides residue in food and their hazards and 37.50 per cent of them were not aware. Among marginal women farmers majority of them i.e. 70.59 per cent were not aware while among large women farmers more than half i.e. 65.22 per cent of them were aware. Among small and medium farmers more than one fourth of them were not aware about pesticides residue in food and their hazards.

4.2.5 Crop Husbandry Practices Followed by Women Farmers

In India, it is very difficult to differentiate the farms on the basis of crop related activities or animal related activities. The activities at farm level are intermingled. In order to qualify the farm as "organic farm" a checklist was prepared (**Appendix VI**) by the investigator in the light of organic production principles. This section deals with crop husbandry practices followed by women farmers. The data were presented in following subheadings:

Record keeping

According to the standards of organic crop production keeping of farm records with respect to production, purchase of food grains, pulses, fruits and vegetables should be maintained in well documented form and receipts should be maintained for inspection. Keeping this in mind, the farmers were asked about the keeping of their farm records but from **table 4.8,** it was reflected that none of the women farmer among all groups used to keep record of her farm inputs or outputs. However, the certification agencies consider it to be one very important requirement under organic management of crops. This finding was supported by **Pathak (2002).**

Table 4.8 : Record Keeping

Practice	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Kept the farm record	-		-	-	-	-	-	-	-	-
Did not keep the records	17	100.00	47	100.00	33	100 00	23	100.00	120	100.00

Breed composition

From the **Table 4.9** it was clear that all the women farmers among various groups were having cows and buffaloes of *desi* breed. None of them was using exotic breed. Thus, the women farmers were following organic standards in this case.

Table 4.9 : Breed Composition

Variety	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Cow										
Desi	17	100.00	47	100.00	33	100.00	23	100.00	120	100.00
Exotic	-	-	-	-	-	-	-	-	-	-
Buffalo										
Desi	17	100.00	47	100 00	33	100 00	23	100.00	120	100 00
Exotic	-	-	-	-	-	-	-	-	-	-

Crop varieties

On the whole more than half i.e. 59.17 per cent of women farmers used high yielding varieties of crops and less than half i.e. 40.83 per cent of them used local variety. None of them used genetically modified varieties of crops (**Table**

4.10). Among marginal women farmers majority of them i.e. 82.36 per cent were using local varieties of crops and 17.64 per cent were using high yielding varieties of crops. On the other hand among small, medium and large farmers most of them were using high yielding varieties of crops and very few of them were using local varieties of crops. It was good from organic farming point of view as the standard for organic production emphasized on use of local varieties and permit the use of high yielding varieties but prohibit the use of genetically modified varieties of crops. This finding is supported by **Pathak (2000)**.

Table 4.10 : Different Varieties of Crops Grown by Farmers

Varieties	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Local	14	82.36	19	40.43	10	30.30	06	26.08	49	40 83
High yielding	03	17.64	28	59.57	23	69.70	17	73 92	71	59 17
Genetically modified	-	-	-	-	-	-	-	-	-	-

Source of seeds

Generally the farmers used seeds from either of their own farms or neighbours farm and from markets based on the availability. On the whole more than half i.e. 54.17 per cent farmers were using seeds of their own farms only 18.33 per cent of them were using from neighbour's farm. Beside this remaining more than one fourth i.e. 27.50 per cent of them were using seeds from market. Slight variation was observed on the basis of size of land holding. The standard for organic production encourages the use of seeds from own farm or from other organic farm. On non-availability, certified organic seeds could be procured from market also, but the regional production of seed is always preferred under the organic production system. (**Table 4.11**)

Table 4.11 : Source of Seed

Source	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Own farm	10	58.82	25	53 20	20	60 60	10	43.48	65	54 17
Neighbor's farm	03	17 65	10	21.27	05	15.16	04	17.39	22	18.33
Market	04	23 33	12	25.53	08	24.24	09	39.13	33	27.50

Pest control methods

The women farmers asked about the different methods they follow for pest control. Different pest control methods followed by them were tabulated in **table 4.12**. On the whole majority of farmers i.e. 65.82 per cent were using all methods of pest control i.e. chemical, physical and biological. Only 4.17 per cent of them were using physical methods. Remaining 18.33 per cent and 11.67 per cent of them were using chemical and biological methods respectively.

Table 4.12 : Different Pest Control Methods Followed by Farmers

Methods	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Chemical	11	64 71	08	17 02	03	9.09	-	-	22	18 33
Physical	-	-	05	10.64	-	-	-	-	05	04 17
Biological	-	-	04	8.51	05	15.15	05	21 74	14	11.67
Above all	06	35.29	30	63 83	25	75 76	18	78 26	79	65 83

Among the marginal women farmers majority of them i.e. 64.71 per cent were using chemical methods and only 35.29 per cent were using all methods of weed control. On the other hand among small medium and large farmers majority of them were using all methods of weed control. With regards to these

practices women farmers failed to be called as organic farmers because use of pesticides is strictly prohibited in organic standards.

Methods of weed control

From the **table 4.13**, it was found that majority of women farmers i.e. 85.83 per cent were using physical methods of weed control in their field and very few of them i.e. 2.50 per cent were using chemical methods of weed control. Remaining 11.67 per cent were using both physical and chemical methods of weed control. Least variation was observed on the basis of size of land holding. However among large farmers all of them were using physical methods of weed control. Physical methods include ploughing of field during sowing or planting of seeds and removal of weeds by hand from the fields. Since, majority of women farmers were using physical methods therefore in this regard, they were qualified for organic production.

Table 4.13 : Methods of Weed Control

Methods	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Chemical	03	17.15	-	-	-	-	-	-	03	02 50
Physical	12	70.58	40	85.11	28	84.84	23	100 00	103	85 83
Both	02	11.76	07	14 89	05	15 16	-	-	14	11.67

Use of synthetic chemicals

The farmers were asked about the use of synthetic chemicals namely chemical fertilizers and chemical fungicides. The data obtained were tabulated in **table 4.14**. It was found that majority of farmers i.e. 70.83 per cent were using both chemical fertilizers and chemical fungicides in little amount in order to optimize the growth of crop production and protect crop from diseases. Remaining 13.34 per cent were using neither chemical fertilizers nor chemical fungicides. Beside this 8.33 per cent of them were using only chemical fertilizers and 7.50 per cent were using only chemical fungicides. Slight

variation was observed on the basis of size of land holding. The farmers failed with respect to use of chemical fertilizers and chemical fungicides which are strictly prohibited in organic farming.

Table 4.14 : Use of Synthetic Chemicals

Synthetic Chemicals	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Chemical fertilizers	04	23.53	06	12.77	-	-	-	-	10	8.33
Chemical fungicides	04	23.53	05	10.64	-	-	-	-	09	07.50
Both	07	41 17	32	68 08	28	84.84	18	78.26	85	70.83
None	02	11 77	04	08.51	05	15.16	05	21 74	16	13.34

Other Miscellaneous Activities

Women farmers were also asked miscellaneous activities like use of organic manure, bio-fertilizers, compost, adoption of integrated pest management (IPM), proper utilization of water, checking of soil erosion, crop rotation, use of green manure.

Data reported in **table 4.15** showed that all the farmers were using compost, bio-fertilizers in their fields but only 4.17 percent of large farmers were adopting integrated pest management practices in their field. Beside this all of them had taken effective measures to check soil erosion. Since there was scarcity of water therefore whenever they got water all of them were properly utilizing the water for irrigation in the fields etc. Beside this all the farmers were following crop rotation and cultivated green manure crop in their fields. Thus women farmers were following organic farming standards in effective way.

Table 4.15 : Other Miscellaneous Activities

Activities	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Use of compost	17	100.00	47	100.00	33	100.00	23	100.00	120	100.00
Use of bio-fertilizers	17	100.00	47	100.00	33	100.00	23	100.00	120	100 00
Follow integrated pest management	-	-	-	-	-	-	05	21.74	05	04.17
Taken measures to check soil erosion	17	100 00	47	100.00	47	100.00	23	100.00	120	100 00
Proper utilization of water	17	100 00	47	100.00	33	100.00	23	100 00	120	100.00
Follow crop rotation	17	100.00	47	100 00	33	100.00	23	100 00	120	100.00
Grow green manure crops in the field	17	100.00	47	100.00	33	100.00	23	100.00	120	100.00

The use of certain practices followed by women farmers were highly appreciated under the standards of organic production for sustainable agriculture. The women farmers followed many practices like use of farmyard manure, cultivation of green manure crops, use of bio-fertilizers etc. But in some aspect they are opposite side of the standards like use of chemical fertilizers, pesticides though they were used in negligible amount.

SECTION III

4.3 Attitude of Women Farmers Regarding Organic Farming

Women in rural areas usually performed both household and agricultural activities. All the rural women of Uttranchal are engaged in organic farming i.e. farming without the use of synthetics, pesticides, chemicals etc. These women are performing various organic activities like collection of cow dung, preparation of organic manure, transportation and application of organic manure in the field, sowing, weeding, harvesting, winnowing etc. During peak period these women have to spend more than 14 hours on daily activities, out of which 8-9 hours were spent on agriculture work. All the decisions regarding farm and household activities were taken by head of the family or jointly by men and women. However, it is necessary to get an insight of women farmers attitude regarding organic farming because they have to perform all the critical organic farming activities. Therefore, in this section an attempt was made by the investigator to understand the attitude of women farmers regarding organic farming. Keeping this in view the Likert type attitude scale was developed.

The scale consisted of 31 statements initially, but after content validity by the experts of different faculties 23 statements remained on the scale. On the basis of item analysis only 13 statements were selected for final data collection. A pilot study was conducted prior to final data collection. Out of 13 statements, five were positive and eight were negative statements Responses were obtained on three points.

The three points on the continuum were 'agree', 'undecided' and 'disagree' with respective weightage of 3,2,1 for positive statements and 1,2,3 for negative statements. The total score for each individual on the scale was computed by summing the weight of the individual item response. The possible score ranged from 13-39.

Categorization of women farmers on their score range on attitude scale

Data in **table 4.16** showed that near about half of the women farmers i.e. 50.83 per cent possessed favourable attitude towards organic farming and less than half i.e. 47.50 per cent of them had neutral attitude towards organic farming while very few of them i.e. only 1.67 per cent had unfavourable attitude towards organic farming. Among the marginal and large women farmers more than half of them had neutral attitude towards organic farming on the other hand among small and medium farmers more than half were having favourable attitude towards organic farming. **(Appendix II)**

Table 4.16 : Categorization of Women Farmers On their Score Ranges on Attitude Scale

Level of Attitude & Score Ranges	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Unfavorable attitude (13-21)	-	-	-	-	02	6.06	-	-	02	01 67
Neutral attitude (22-30)	10	58.83	21	44 68	13	39.40	13	56 53	57	47.50
Favorable attitude (31-39)	07	41.17	26	55 32	18	54 54	10	43 47	61	50 83

None of the marginal, small and large farmer had unfavourable attitude towards organic farming only 6.06 percent of medium farmers had unfavourable attitude towards organic farming.

SECTION IV

4.4 Critical Activities Performed by Women Farmers

On the basis of review of literature it was found that those activities in which heart rate goes beyond 105 – 110 beats /minute are called critical activities. In agriculture all those activities which are performed by women farmers without the use of synthetics, chemical fertilizers pesticides are considered as organic farming activities. Therefore, following activities were selected as organic farming activities. Moreover, on the basis of standardization they were considered as critical activities and their sequence was decided on the basis of daily sequence followed by women farmers.

4.4.1 Sequence of Selected Critical Activities

Collection of cow dung from cattle shed, transportation of cow dung to manure shed, preparation of organic manure, transportation of manure to the field, digging of the land, application of manure in the field, sowing, weeding, harvesting and winnowing.

4.4.2 Type of Technologies used by Women Farmers

Women in rural hilly areas have been shaping the country's economy through their active participation in agriculture. Women in agriculture are performing all the activities except ploughing but very little attention has been focused on women and technology. Tools and equipment used by women farmers were not according to their body dimensions, experiences, skills and stamina due to which they alleviate drudgery and several health hazards while performing various agricultural activities. Therefore, there is an urgent need to study the technologies used by women farmers in various organic farming activities, so that further improvement in technologies can be made and women friendly technologies can be designed. Type of technologies used by women farmers among various critical activities are presented in **table 4.17**

Table 4.17 : Type of Technologies Used by Women Farmers

Type of Technologies	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Collection of cow dung from cattle shed										
Hand	-	-	-	-	-	-	-	-	-	-
Broom	-	-	-	-	-	-	-	-	-	-
Tub	-	-	-	-	-	-	-	-	-	-
Bucket	-	-	-	-	-	-	-	-	-	-
Above all	17	100.00	47	100.00	33	100.00	23	100.00	120	100.00
Transportation of cow dung to manure shed										
Tub	11	67.71	35	74 46	12	36.37	06	26.09	64	53.33
Bucket	06	35.29	12	25.54	21	63.63	17	73.91	56	46 67
Preparation of organic manure										
Hand										
Tub / Bucket										
Both	17	100.00	47	100.00	33	100.00	23	100.00	120	100 00
Transportation of organic manure to field										
Tub	11	67.71	35	74.46	12	36.37	06	26.09	64	53.33
Bucket	06	35.29	12	25.54	03	9.09	02	8.69	23	19.17
Tractor Trolley	-	-	-	-	18	54.55	15	45 22	33	27.50
Digging of land										
Small handle spade	05	27 41	22	46.80	09	27.27	05	21 74	41	34.17
Long handle spade	-	-	04	8.51	06	18.18	07	30.43	17	14 17
Kudal	12	7.58	21	44 68	18	54 54	11	47 83	62	51 66
Application of manure in the field										
By hand	17	100.00	47	100 00	33	100.00	23	100.00	120	100 00
Sowing / transplanting of seeds										
With hand	17	100.00	20	42 56	09	27.27	05	21.74	51	42 50
Seed driller	-	-	-	-	10	30.30	09	39.13	19	15.83
Behind the plough	-	-	27	57 44	14	42.43	09	39 13	50	41 67
Weeding										
Small handle hoe	-	-	-	-	05	15.15	05	21.74	10	8.33
Long handle hoe	-	-	-	-	10	30.30	08	34 78	18	15 00
Kurpi	17	100.00	47	100 00	18	54.55	10	43.48	92	76.67
Harvesting										
With sickle	17		47		33		23		120	100.00
Winnowing										
Winnower	-	-	-	-	18	54 55	16	69 57	34	28.33
Hand beating with soup & fan	17		17		15	45 45	07	30 43	86	71 67

Collection of cow dung from cattle shed

It was found that when collection of cow dung from cattle shed was done all the women farmers used hand, broom, tub and bucket. There was no difference on the basis of size of land holding.

Transportation of cow dung to manure shed

It was noted that when transportation of cow dung to manure shed was done about half i.e. 53.33 per cent of them were using tub on their heads and less than half of them i.e. 46.67 per cent used buckets in their hands. Among marginal farmers majority of them i.e. 67.71 per cent used tub, and more than half i.e. 35.29 per cent used buckets.

Similar trend was followed by small farmers. On the other hand among medium and large farmers majority of them used bucket and less than half of them used tub.

Preparation of organic manure

When preparation of organic manure was done all the women farmers used hand, tub and bucket. No difference was observed on the basis of size of land holding.

Transportation of organic manure to field

When transportation of organic manure to field was done more than half i.e. 53.33 per cent women farmers used tub and more than one fourth of them i.e. 27.50 per cent used tractor trolley. Remaining 19.17 per cent of them used bucket. Among marginal and small farmers majority of them used tub and none of them used tractor trolley. Among medium farmers more than half i.e. 54.55 per cent used tractor trolley and less than half i.e. 36.37 per cent used tub. Only 9.09 per cent used bucket. Among large farmers majority of them i.e. 65.22 per cent used tractor trolley and more than one fourth of them i.e. 26.09 per cent used tub. Remaining 8.69 per cent used bucket

Plate 1 : Collection of Cow dung from Cattle shed

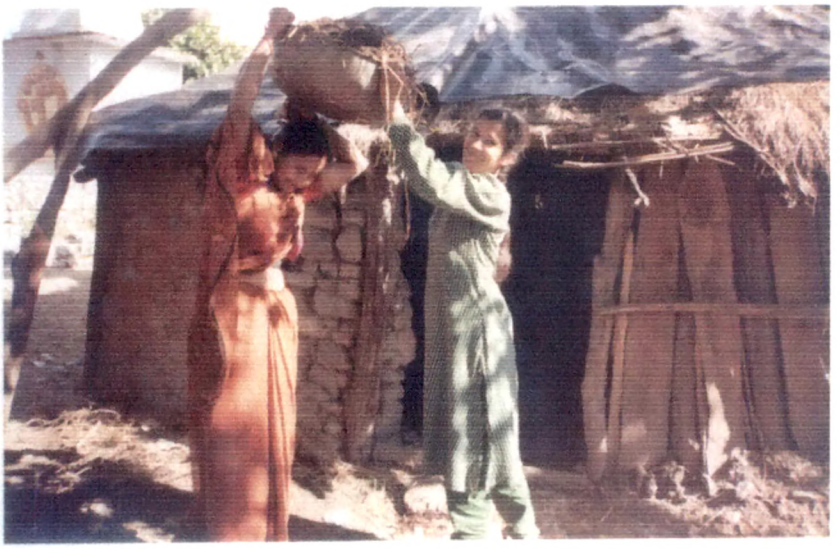


Plate 2 : Transportation of Cow dung to Manure shed

Digging of land

On the whole about 51.66 per cent women farmers used '*kudal*' for digging of land and less than half i.e. 34.17 per cent used small handle spade. Remaining 14.17 per cent used long handle spade. Among marginal women farmers majority of them i.e. 70.58 per cent used '*kudal*' for digging of land and more than one fourth of them i.e. 29.41 per cent used small handle spade. None of them used long handle spade. Among small women farmers less than half of them used either small handle spade or '*kudal*' and rest of them i.e. 8 51 per cent used long handle spade. Among medium and large women farmers most of them used '*kudal*' for digging of land.

Application of manure in the field

It was recorded that for applying manure in the field all the women farmers used hand. No variation was observed on the basis of size of land holding

Sowing / transplanting of seeds

It was observed that when sowing of seeds was done 42.50 per cent women used hand and 41.67 per cent of women sow seeds behind the plough. Remaining 15.83 per cent used seed driller for sowing / transplanting of seeds. Among marginal farmers all of them used 'hand' for sowing / transplanting of seeds.

Among small farmers more than half i.e. 57.44 per cent sowed seeds behind the plough and less than half i.e. 42.56 per cent used hand. None of them used seed driller for sowing of seeds. Among medium and large farmers less than half of them sowed seeds behind the plough and by using and seed driller, and rest of them used only hand.

Weeding

When weeding was done majority of women farmers i.e. 76.67 per cent used '*khurpi*' and very few of them i.e. 8.33 per cent used small handle hoe. Remaining 15.00 percent used long handle hoe Among marginal, and small farmers all of them used '*khurpi*'. None of them used small and long handle

hoe. On the other hand among medium farmers more than half i.e. 54.55 per cent used '*khurpi*' and less than one fifth of them i.e. 15.15 per cent used small handle hoe. Remaining 30.30 per cent of them used long handle hoe. Among large women farmers less than half i.e. 43.48 per cent used '*khurpi*' and about one fifth of them i.e. 21.74 per cent used small handle hoe and remaining 34.78 per cent used long handle hoe.

Harvesting

It was found that for harvesting all the women farmers used traditional sickle. None of them used other technology. No difference was observed on the basis or size of land holding.

Winnowing

When winnowing was done majority of women farmers i.e. 71.67 per cent did hand beating with the help of *soupa* and fan and remaining 28.33 per cent used winnower. Among marginal and small farmers all of them used hand beating with the help of *soupa* and fan and none of them used winnower. One the other hand among medium and large farmers more than half of them used winnower and rest of them used hand beating with the help of *soupa* and fan. Thus, the technologies used by women farmers while performing various critical activities were more or less traditional.

4.4.2 Time Spent and Distance Travelled and Posture Adopted by Women Farmers in Various Critical Activities

Women farmers have to spend considerable amount of time in carrying out various critical activities of agriculture during lean and peak season. During hoeing, weeding, harvesting, women farmers have to spend 7-8 hours in a field. **Charkavarti (1995)** found that a female spent 15-17 hours in a day out of which 8 to 9 hours were spent on farm, 3-4 hours in care of animals and 3-4 hours in attending household chores during peak season. Average time spent, distance travelled and posture adopted by women farmers in various critical activities are described in **table 4.18**.

Table 4.18 : Time Spent, Distance Travelled and Posture Adopted by Women Farmers in Various Critical Activities

Critical Activities	Average Time Spent (Minute)	Distance Travelled (Meter)	Posture Adopted
Collection of cow dung from cattle shed	30	10.0	Squatting
Transportation of cow dung to manure shed	15	68.0	Standing
Preparation of organic manure	180	96.0	Standing cum bending
Transportation of organic manure to field	120	92.0	Standing
Digging of land / seed bed preparation	180	48.0	Squatting cum bending
Application of manure in the field	180	24.5	Sitting or standing
Sowing / transplanting of seeds	180	10.0	Standing cum bending
Weeding	360	32.5	Squatting cum bending
Harvesting	480	24.0	Squatting cum bending
Winnowing	360	02 0	Standing cum bending

Collection of cow dung from cattle shed

It was noted that when collection of cow dung from animal shed was done the distance travelled by women farmers was 10 meters. During this activity posture adopted by them was "squatting". Collection of cow dung from cattle shed depend upon number of livestock. Average time spent on collection of cow dung from cattle shed was 30 minutes.

Transportation of cow dung to manure shed

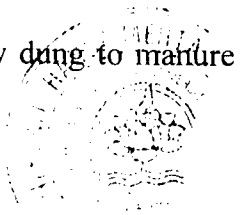
When transportation of cow dung to manure shed was done distance travelled by women farmers was 68 meters. During this activity posture adopted by them

3a

3b

Plate 3a & 3b : Preparation of Organic Manure

was "standing". Average time spent in transportation of cow dung to manure shed was 15 minutes.



Preparation of organic manure

It was observed that when preparation of organic manure was done women farmers travelled 96 meters. During this activity women farmers adopted various postures like for spreading of cow dung, they used "standing cum bending" posture and for fetching water they used "standing" posture. Preparation of organic manure was time consuming task because for making compost moist, women farmers fetched water from far distances. Average time spent during preparation of organic manure was 180 minutes.

Transportation of organic manure to the field

While transporting organic manure to the field distance travelled by them were 92 meters. During transportation of organic manure to the field women farmers adopted "standing" posture. Transportation of manure was a strenuous activity performed by the women farmers because they carried 15 to 20 kgs of organic manure on their head. Average time spent during this activity was 120 minutes.

Digging of land/seed bed preparation

When digging of land/seed bed preparation was done distance travelled by them were 48 meters. During this activity women farmers used "squatting cum bending" posture. It was found that when digging of land/seed bed preparation was performed by the women farmers average time spent by them was 180 minutes.

Application of manure in the field

It was found that when application of manure in the field was done distance travelled by women farmers was 24.5 meters. During application of manure in the field, women farmers used either "sitting" or "standing" posture. Organic manure was applied in the field after digging of land/seed bed preparation. Average time spent during application of organic manure in the field was 180 minutes.

Sowing / transplanting of seeds

It was noticed that when sowing/transplanting of seeds was performed by women farmers distanced travelled by them was 10 meters. During sowing/ transplanting of seeds women farmers used "standing cum bending" posture. It was found that when sowing / transplanting of seeds was done by the women farmers average time spent by them was 180 minutes.

Weeding

It was found that when weeding was done distance travelled by women farmers was 32.5 meters. Posture adopted during weeding was "squatting cum bending". Weeding is a very time consuming activity because if proper care is not taken during weeding then productivity of crop reduces. It was observed that during weeding average time spent by women farmers was 180 minutes.

Harvesting

When harvesting was done distance travelled by women farmers was 24 meters. Posture adopted during harvesting was "squatting cum bending". Harvesting is also very time consuming activity. Average time spent by women farmers during harvesting of paddy was 480 minutes.

Winnowing

When winnowing was done distance travelled by women farmers was 2 meters. Posture adopted during winnowing was "standing cum bending". After harvesting of crops, winnowing was done. It was noticed that during winnowing average time spent by women farmers was 360 minutes.

Thus, on the basis of this finding it was concluded that women farmers spent maximum time (480 minutes) on harvesting and minimum during transportation of cow dung to manure shed (15 minutes). Besides this, distance travelled by women farmers was highest during preparation of organic manure (96 meters) and it was lowest during winnowing (2 meters). Mode of posture adopted by women farmers while carrying out various activities was mainly "squatting cum bending".

SECTION - V

4.5 Body Discomfort Experienced by Women Farmers in Different Organic Farming Activities

Discomfort may be defined as the body pain arising as a result of the working posture or excessive stress on muscles due to the effort involved in the activity. Women in rural areas are usually employed in arduous field operations like sowing behind plough, collection and transportation of cow dung to manure shed, weeding and harvesting etc. All these operations were carried by women farmers either manually or by using tools/equipment, which were primarily developed for male farmers, as a result the output of women farmers was very low. Beside this many occupational health problems also crop up. Since in Uttranchal most of the rural women have been involved in organic farming therefore investigator was interested in studying in depth information on body discomfort/health problems experienced by women workers. "Single noun verbal rating scale" for discomfort intensity (**Straker, 1999**) was adopted. Data was collected with the help of body map (**Fig 4.1**). On the basis of the scale body discomfort experienced by women farmers were categorized into three points i.e. severe discomfort, moderate discomfort and no discomfort with respective weightage of 3,2,1. The possible score ranged from 10-30.

4.5.1 Percentage Distribution of Women Farmers on the Basis of Body Discomfort Experienced by Them

Table 4.19(a) and fig. 4.2 presents body discomfort experienced by women farmers in various organic farming activities. They are discussed under following sub-headings :

Backache

It was observed from **table 4.19a** that more than half i.e. 67.50 per cent women farmers had severe backache and one fifth of them had no backache. Remaining 11.67 per cent had moderate backache Among marginal and large women farmers majority of them had severe backache while among small and

Table 19b.: Body Discomfort Experienced by Women Farmers in Various Critical Activities

Body Discomfort	Marginal (n=17)			Small (n=47)			Medium (n=33)			Large (n=23)			Total (N = 120)		
	S	M	N	S	M	N	S	M	N	S	M	N	S	M	N
Backache	82.35	-	17.65	55.32	14.89	29.79	66.67	18.18	15.15	82.61	4.35	13.04	67.50	11.67	20.83
Headache	41 17	23.53	35 30	17 02	31 91	51.07	18.18	39.40	42.42	4.35	60.87	34.78	18.34	38.33	43.33
Limb pain	76.48	11.76	11 76	57 45	21.28	21.28	45.46	27.27	27.27	56.52	34.78	8.70	56.66	24.47	19.17
Chest pain	35 30	5.88	58.82	21 28	17.02	61.70	12 12	24.24	63.64	8.70	21.74	69.57	18.33	18.33	63 34
Palm pain	64 71	23.23	11.76	44 68	17 20	38.30	39.40	15.15	45.45	39.13	21 74	39.13	45 00	18 33	36.67
Forearm pain	76 48	11.76	11.76	68.09	17 02	14 89	66.67	9.09	24.24	78.26	17.39	4.35	70.83	14 17	15 00
Muscles pain	64.71	11.76	23.53	61 70	8 51	29.79	63 64	15.15	21.21	78.26	8.70	13.04	65.83	10.83	23.34
Knee pain	64 71	- -	35.30	61 70	10.64	27 66	60.61	9.09	30 30	65.22	8 70	26.08	62.50	8.33	29 17
Foot pain	70.59	11.76	17.65	46.81	6.38	46.81	57.58	12.12	30.30	60.87	8.70	30.43	55.83	9.71	35.00
Lumber pain	88.24	-	11 76	72 34	2 13	25.53	72.73	-	27.27	91 30	4 35	4.35	78 33	1.67	20 00

S = Severe discomfort M = Moderate discomfort N = No discomfort

medium farmers more than half of them had severe backache. Thus, backache was prominent among these women farmers.

Headache

Headache was not very common among them. On the whole less than one fourth i.e. 18.34 per cent had severe headache and less than half i.e. 44.33 per cent had no headache. Remaining 38.33 per cent had moderate headache. Among the marginal women farmers less than half i.e. 41.17 per cent had severe headache. Slight variation was observed among rest of the group regarding headache.

Limb pain

It was found that more than half i.e. 56.66 per cent women farmers had severe limb pain and less than one fifth i.e. 19.17 per cent had no limb pain. Remaining less than one fourth i.e. 24.17 per cent had moderate limb pain. Among marginal farmers majority of them i.e. 76.48 per cent had severe limb pain and less than one fifth i.e. 11.76 per cent had moderate pain and no pain. Slight variation was observed among small, medium and large farmers.

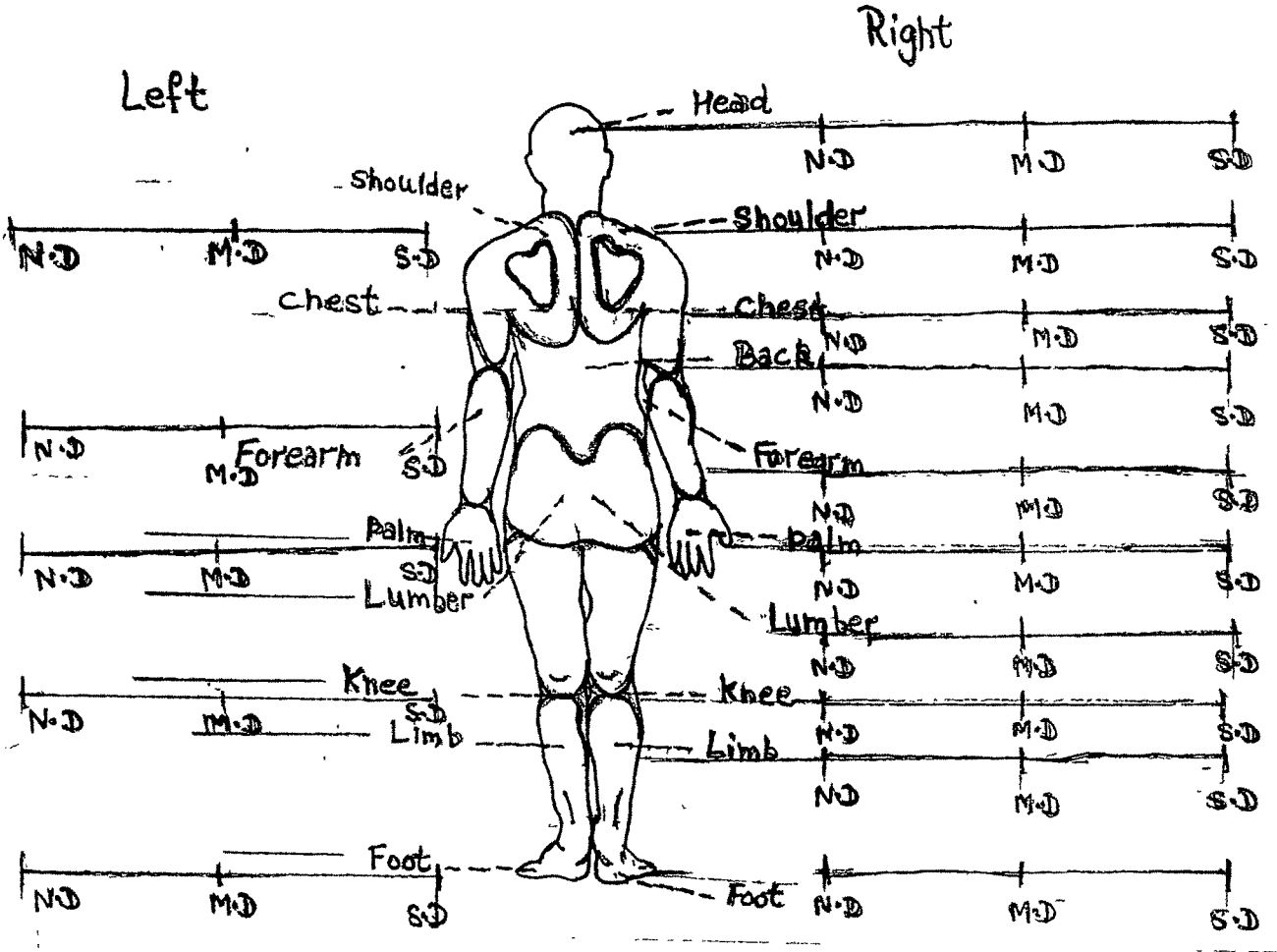
Chest pain

Chest pain was least common among women farmers. On the whole less than one fifth i.e. 18.33 per cent had severe chest pain and more than half i.e. 63.34 per cent had no chest pain. Remaining less than one fifth i.e. 18.33 per cent had moderate chest pain. Among marginal farmers less than half i.e 35.30 per cent had severe chest pain and more than half i.e. 58.82 per cent had no chest pain. Remaining 5.88 per cent had moderate chest pain. On the other hand among small, medium and large farmers less than one fifth of them had severe chest pain and majority of them had no chest pain.

Palm pain

It was found that less than half i.e. 45.00 per cent of them had severe palm pain and one third of them i.e. 36.67 per cent had no palm pain. Remaining 18.33 per cent had moderate palm pain. Among marginal farmers more than half i.e.

Fig-4:1 Body Map Showing Body Discomfort Location Intensity



ND = No Discomfort.
MD = Moderate Discomfort
SD = Severe Discomfort

64.71 per cent had severe palm pain and only. 11.76 per cent had no palm pain. Remaining less than one fourth i.e. 23.53 per cent had moderate palm pain. Slight variation was observed among rest of the groups.

Forearm pain

It was noted that majority of women farmers i.e. 70.83 per cent had severe forearm pain and less than one fifth i.e. 15.00 per cent of them had no forearm pain. Remaining 14.17 per cent had moderate forearm pain. Slight variation was observed on the basis of size of land holding.

Calf muscles pain

Calf muscles pain was also very common among women farmers. Majority of them i.e. 65.83 per cent had severe calf muscles pain and less than one fourth i.e. 23.34 per cent had no calf muscles pain. Remaining 10.83 per cent had moderate calf muscles pain. Slight variation was observed on the basis of size of land holding.

Knee pain

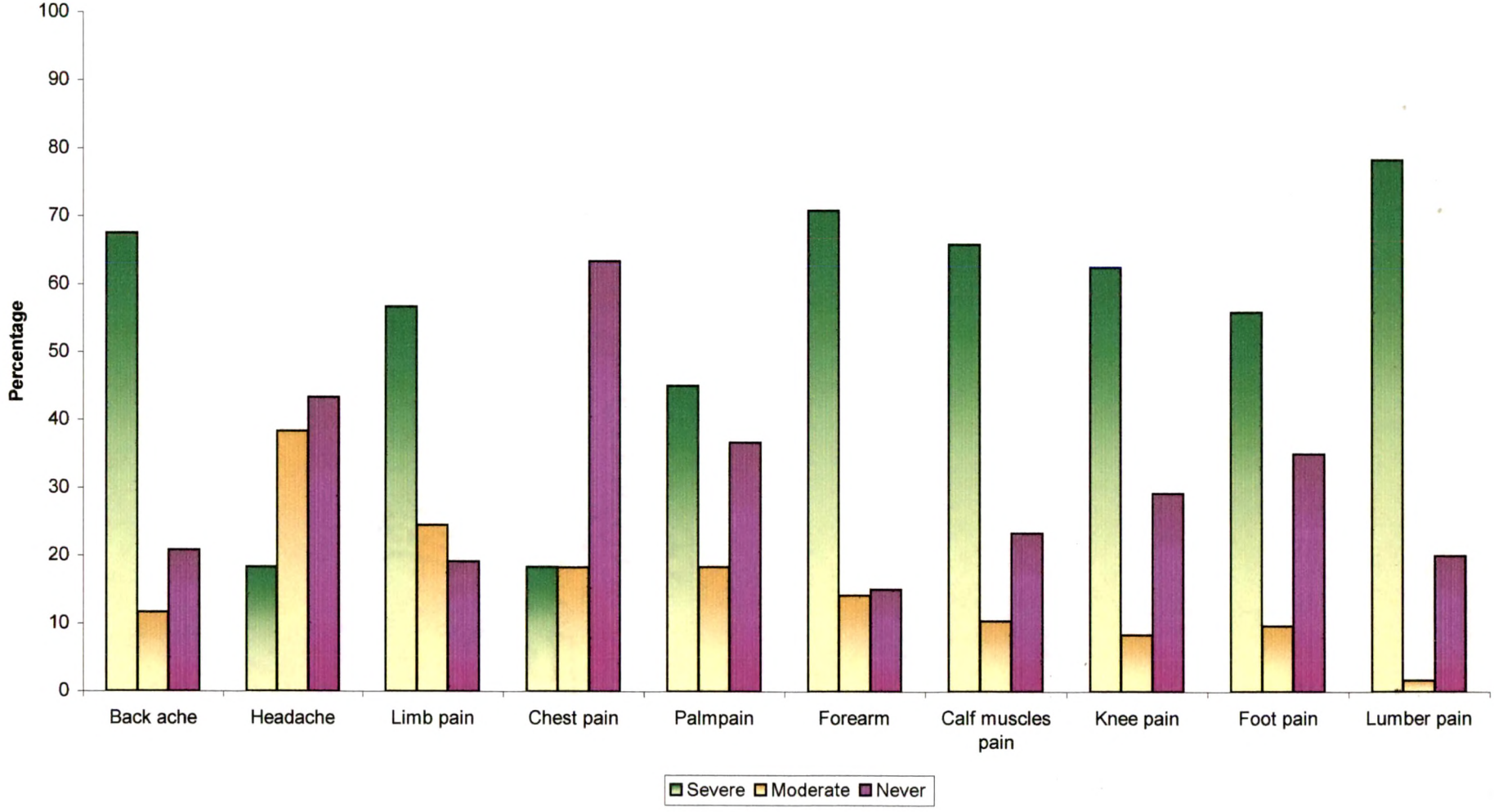
Since women farmers have been spending long hours in squatting posture during collection of cow dung, digging of land/seed bed preparation, weeding, harvesting etc. therefore, knee pain was very common among them.

On the whole majority of them i.e. 62.50 per cent had severe knee pain and more than one fourth of them i.e. 29.17 per cent had no knee pain only 8.33 per cent had moderate knee pain. Slight variation was observed on the basis of size of land holding.

Foot pain

Women farmers used to walk 6-8 km daily for transportation of cow dung to manure shed, transportation of manure to the field, fetching of water, fuel and fodder etc. therefore, foot pain is one of the major occupational health problem reported by them. It was observed that more than half i.e. 55 83 per cent of women farmers had severe foot pain and less than half i.e. 35.00 per cent had

Figure 4.2 : Graphical Representation of Body Discomfort Experienced by Women Farmers



no foot pain. Remaining 9.17 per cent had moderate foot pain. Slight variation was observed on the basis of size of land holding.

Lumber pain

Lumber pain was very severe among all women farmers because they performed most of the activities in squatting posture for long hours. On the whole majority of them i.e. 78.33 per cent had severe lumber pain and one fifth of them i.e. 20.00 per cent had no lumber pain. Only 1.67 per cent had moderate lumber pain. Slight variation was observed on the basis of size of land holding.

Thus, on the basis of this finding descending order of body discomfort experienced by women farmers was lumber pain, forearm pain, backache, calf muscles pain, knee pain, chest pain, and headache.

4.5.2 Categorization of Women Farmers on the Basis of Intensity of Body Discomfort

From data reported in **table 4.19(b)** it was found that less than half i.e. 41.67 per cent of women farmers had severe body discomfort and less than one fifth i.e. 15.83 per cent of them had no body discomfort. Remaining 42.50 per cent had moderate body discomfort.

Table 4,19(b) : Categorization of Women Farmers on the Basis of Intensity of Body Discomfort

Category & Score Ranges	Marginal (n=17)		Small (n=47)		Medium (n=33)		Large (n=23)		Total (n=120)	
	F	%	F	%	F	%	F	%	F	%
Severe discomfort (10-16)	10	58.82	16	34.04	14	42 42	10	43 48	50	41 67
Moderate discomfort (17 –23)	06	35.30	23	48.94	10	30.30	12	52.17	51	42 50
No discomfort (24 - 30)	01	5.88	08	17.02	09	27 28	01	4.35	19	15 83

SECTION VI

4.6 Experimental Data

Ergonomic Assessment of Workload in Various Critical Activities

Ergonomics (Human Engineering) is the scientific study of relationship between man, machine and environment. The term environment include her/his tools and materials, her/his method of work, ambient conditions and physical environment of work and also the organisation of work. The women farmers involved in organic farming undergo drudgery. They have to perform several organic farming activities like collection of cow dung, transportation of cow dung to manure shed, preparation of organic manure, transportation of manure to fields, digging of land, application of manure in the field, sowing of seeds, weeding, harvesting and winnowing. All these activities are critical activities and cause lots of workload on women farmers. The goal of ergonomics is to increase efficiency and thereby productivity of the workers without jeopardizing their health and safety. Now-a-days it is being realized that ergonomics is equally important and relevant in agricultural activities as most of the rural women are exclusively involved in agriculture. Therefore this section deals with physical fitness of women farmers involved in organic farming beside this workload in terms of heart rate, energy expenditure and muscular stress (grip strength) were also examined in various critical activities performed by women farmers involved in organic farming.

4.6.1 Physical Characteristics of the Selected Women Farmers

Anthropometic data are very useful in deciding the workload experienced by women farmers beside this it is imperative to give due consideration to this aspect while designing tools and equipment used in various organic farming activities. **Table 4.20** gives the mean values, standard error, ranges and coefficient of variation for age, body weight and standing height of women farmers.

Table 4.20 : Physical Characteristic of the Selected Women Farmers

Subject No.	Age (year)	Body Weight (kg)	Standing Height (cm)
1	26	40	165 10
2	26	47	162 56
3	20	40	154 94
4	31	52	170 18
5	31	45	152 40
6	20	45	156 21
Range	20-31	40-52	152 40-170 18
Mean	25 66	44 83	160 23
S E	2 01	1 85	2 79
C V	19 19	10 11	4 26

The data presented in **table 4.20** is described under following sub-headings.

Age

It is very important parameter. Body dimensions changes especially during puberty. In general increase of height ends for women at 18th year and for men at 20th year. It varies with socio-economic groups From **table 4.20**, it was examined that age of selected women farmers were varied from 20 - 31 years Mean age of women farmers were 25 66 years with standard error of 2 01 Co-efficient of variation (CV) was 19 19

Body weight

Weight of women farmers ranged from 40 - 52 kg. Mean weight of women farmers was 44.83 kg with standard error of 1 85 Coefficient of variation (cv) was 10 11 This finding is supported by **CIAE (2000)** and **AICRP (2000)**

where they indicated that mean weight of women farmers was 45 kg as against 50 kg for male farmers.

Standing height

Standing height of women farmers ranged from 152.40-170 18 cm Mean height of women farmers was 160 23 cm with standard error of 2.79 and co-efficient of variation was 4 26. This finding was supported by **Tewari et al (1991).**

4.6.2 Physical Fitness Test of Selected Women Farmers

Physical fitness index (PFI), aerobic capacity (Vo_2 max) and body type (Ponderal Index) of women farmers were examined in **Table 4.21**

Physical fitness index (PFI)

Physical fitness index of women farmers were examined with the help of step - stool ergometer. Then physical fitness index of women farmers was calculated. From **table 4.21** it was evident that mean PFI of women farmers was 102 79 ± 6.90 which showed that women farmers were having high average of PFI. Moreover from table **4.21** it was found that out of six women farmers three of them were having low average (81 - 100) PFI and only two of them were having good physical fitness index (116 - 135). None of them were having excellent (beyond 150) PFI Physical fitness index of women farmers ranged from 87.46 - 122.44. This finding was similar to **AICRP (2001).**

Aerobic capacity

Maximum aerobic capacity (also called as maximum oxygen intake capacity or Vo_2 max) is considered as an international reference standard of cardio-respiratory fitness. The Vo_2 max is dependent on many factors such as race, age, sex, body built up etc Aerobic capacity (Vo_2 max) of women farmers were presented in **table 4.21**. Aerobic capacity of women farmers ranged from 19 37 - 37 67 ml/kg min Mean aerobic capacity of women farmers was 32 32 ± 6.43 ml/kg min which indicated that they were having good aerobic capacity. Out of six women farmers three of them were having low average (16.0 - 25.0)

Table 4.21 : Physical Fitness Test of Selected Women Farmers

Physical Fitness Index (PFI)	Women Farmer (n=6) f	Aerobic Capacity (Vo_2 Max.)	Women Farmer (n=6) f	Body Type (PI)	Women Farmer (n=6) f
Poor (up to 80)	-	Poor (up to 15)	-	Ectomorphic	-
Low average (81-100)	3	Low average (16 - 25 0)	3	(< 20)	-
High average (101-115)	1	High average (26 - 30)	1	Mesomorphic	-
Good average (116-135)	2	Good (31 - 40)	2	(20 - 25)	-
Very good (136-150)	-	Very good (41 - 45)	-	Endomorphic	6
Excellent (beyond 150)	-	Excellent (beyond –45)	-	(> 25)	-
Mean ± S E	102 79±6 90	Mean ± S E	32 32 ± 6 43	Mean ± S E	45 15 ± 0 61

* n = sample size

$$PFI = \frac{\text{Duration of stepping (sec)}}{\text{Sum of Ist, } 2^{nd} \text{ and } 3^{rd} \text{ min recovery pulses count}} \times 100$$

Vo_2 Max = 0 023 x body weight (kg) – 0 034 x age (yrs) + 1 652

$$PI = HW^{-1/3}$$

aerobic capacity only two of them were having good (31-40) aerobic capacity. None of them were having excellent (beyond 45) aerobic capacity. This findings is congruent with **AICRP (2001)**.

Body type (Ponderal index)

Ponderal index of women farmers ranged from 42.81 – 48.27. Mean ponderal index of women farmers was 45 15 ± 0 61. All the women farmers were endomorphic. This finding is similar to **AICRP (2001)**.

4.6.3 Cardio-vascular Stress Among Different Critical Activities Experienced by Women Farmers

Cardio-vascular stress (beats/minute) of six women farmers were recorded during different critical activities. Procedure for recording was based on test code provided by Central Institute of Agricultural Engineering (CIAE), Bhopal The three trials were planned statistically using randomized plot design so as to get meaningful data. Each trial was 15 minutes duration. Percentage increase in heart rate over rest was calculated with the help of formula.

From **table 4.22** it was observed that heart rate of women farmers increased during different critical activities and on the bases of classification given by **Varghese (1994)** all the activities were classified as moderately heavy activities Heart rate during various critical activities were described under the following sub-headings.

Collection of cow dung from cattle shed

On the basis of One-way ANOVA Test, statistical comparison of cardiovascular stress during collection of cow dung from cattle shed indicated that mean heart rate during rest (75 16 ± 1.04) was significantly ($p \leq 0.01$) lower than mean heart rate during work (106 40 ± 0 89). Further analysis of critical difference indicated that mean heart rate (106.40 ± 0.89) during collection of cow dung from cattle shed was significantly ($p \leq 0\ 01$) lower than

Table 4.22 : Cardio-Vascular Stress (beats / minute) Among Different Critical Activities Experienced by Women Farmers

Critical Activities	Cardio - vascular stress (beats/ min.)				
	Heart rate during rest Mean±S.E	Heart rate at work Mean±S.E	Increase over rest	% Increase over rest	Classification of workload
Collection of cow dung from cattle shed	75 16 ± 1.04a	106.40 ± 0.89 acdeij	31.24	41.56	Moderately heavy
Transportation of cow dung to manure shed	76.00 ± 0.68b	110.46 ± 0.41 bcdj	34.46	45.34	Moderately heavy
Preparation of organic manure	75.00 ± 1 12c	121.44 ± 4.65 cabefghij	46 44	61 92	Moderately heavy
Transportation of organic manure to field	78.16 ± 1.30d	119.56 ± 0.56 dabefghi	41.40	52.96	Moderately heavy
Digging of land / seed bed preparation	76.00 ± 0.96e	111.49 ± 1.54 eacdf	35 49	46.70	Moderately heavy
Application of manure in filed	75 00 ± 1.12f	106.16 ± 0 57 bcdeij	31.16	41.55	Moderately heavy
Sowing / transplanting of seeds	75.00 ± 1.21g	109 71 ± 1.05 gcdj	34.71	46.28	Moderately heavy
Weeding	75.00 ± 1 21h	108.34 ± 1 17 hcdij	33.34	44.46	Moderately heavy
Harvesting	75 00 ± 1.21I	113.59 ± 0.24 iacdfhj	38.59	51.46	Moderately heavy
Winnowing	75.00 ± 1.23j	115.48 ± 0.29 jabcfghi	40 48	53.97	Moderately heavy

Increase over rest = HR at work - HR during rest

$$\% \text{ Increase over rest} = \frac{\text{HR during work - HR during rest}}{\text{HR during rest}} \times 100$$

Mean value with different superscripts was significantly ($p \leq 0\ 01$) different from one another (on the basis of One-way ANOVA test).

preparation of organic manure (121.44 ± 4.65), transportation of organic manure to the field (119.56 ± 0.56), harvesting (113.59 ± 0.24) and winnowing (115.48 ± 0.29). It was further analysed that mean heart rate during collection of cow dung from cattle shed (106.40 ± 0.89) was also significantly ($p \leq 0.01$) lower than digging of land. Moreover, mean heart rate during collection of cow dung from cattle shed (106.40 ± 0.89) was non-significant when related to transportation of cow dung to manure shed (110.46 ± 0.41), application of manure in the field (106.16 ± 0.57), sowing / transplanting of seeds (109.71 ± 1.05) and weeding (108.34 ± 1.17) in the field.

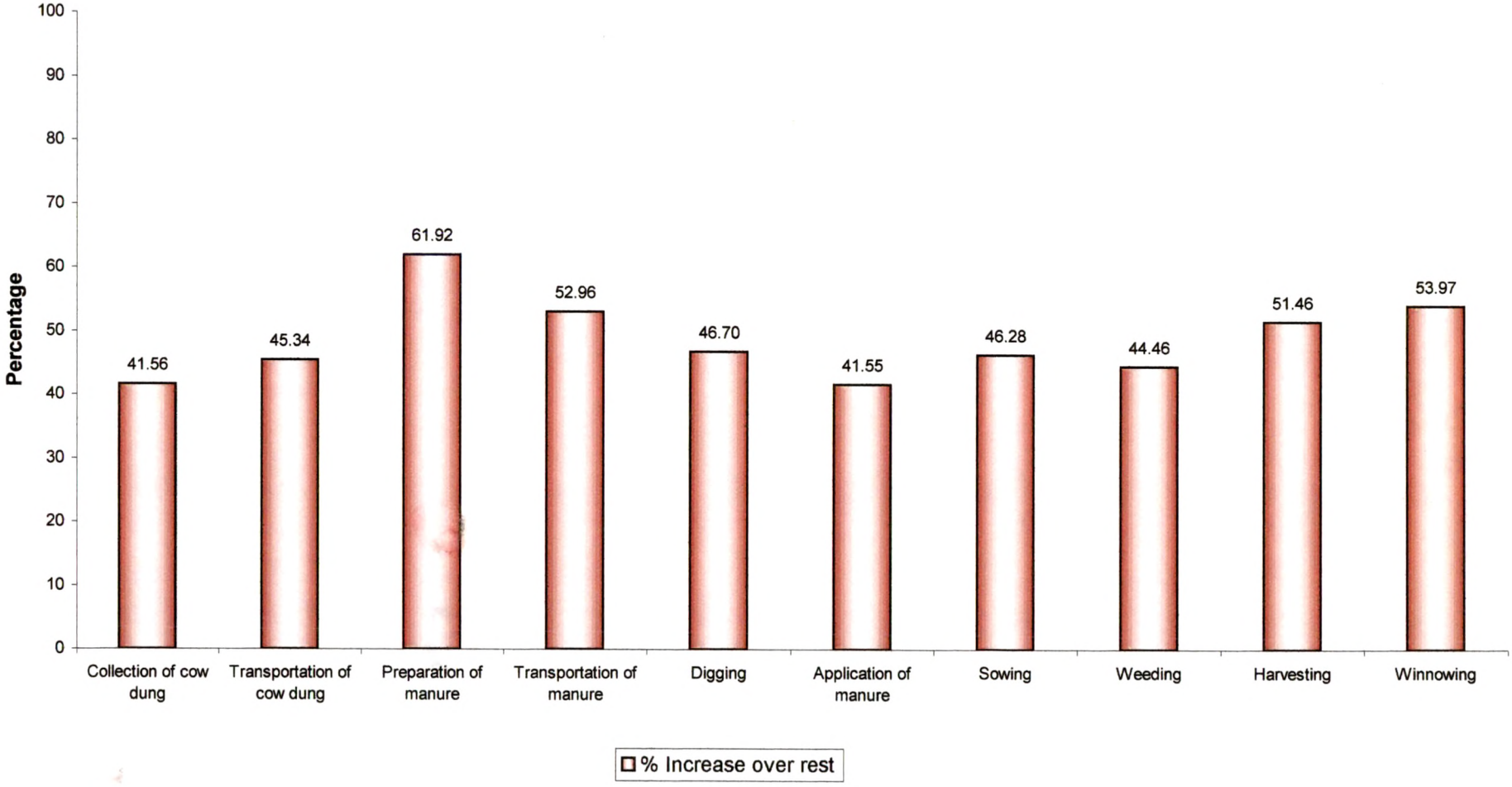
Percentage increase in heart rate over rest

Table 4.22, also throw light on percentage increase in heart rate over rest. It was observed that when collection of cow dung from cattle shed was done percentage increase in mean heart rate over rest was 41.56 which was lowest than all other critical activities except application of manure in the field (41.55).

Transportation of cow dung to manure shed

Mean heart rate during rest (76.00 ± 0.68) was significantly lower than mean heart rate during work (110.46 ± 0.41). Statistical comparison of cardiovascular stress during transportation of cow dung to manure shed showed that mean heart rate during transportation of cow dung to manure shed (110.46 ± 0.41) was significantly ($p \leq 0.01$) lower than preparation of organic manure (121.44 ± 4.65), transportation of organic manure to the field (119.56 ± 0.56). Beside this, it was also significantly ($p \leq 0.05$) lower (110.46 ± 0.41) than winnowing (115.48 ± 0.29). Moreover, transportation of cow dung to manure shed was non-significant when related to collection of cow dung from cattle shed (106.40 ± 0.89) digging of land (111.49 ± 1.54), application of manure in the field (106.16 ± 0.57), sowing (109 71 ± 1.05), weeding (108.34 ± 1.17) and harvesting (113.59 ± 0.24).

Figure 4.3 : Graphical Representation of Cardiovascular Stress (beats/min) Experienced by Women Farmers



Percentage increase in heart rate over rest

During transportation of cow dung to manure shed percentage increase in heart rate was 45.34. It was higher than collection of cow dung from cattle shed (41.56), application of manure in the field (41.55), weeding (44.46) and lower than preparation of organic manure (61.92), transportation of organic manure to field (52.96), digging of land (46.70), sowing (46.28) harvesting (51.46) and winnowing (53.97).

Preparation of organic manure

Mean heart rate during rest (75.00 ± 1.12) was significantly ($p \leq 0.01$) lower than mean heart-rate during work (121.44 ± 4.65). After transportation of cow dung to manure shed, organic manure was prepared by women farmer. Cardio-vascular stress (beats/min) during preparation of organic manure (121.44 ± 4.65) was significantly ($p \leq 0.01$) higher than collection of cow dung from cattle shed (106.40 ± 0.89), transportation of cow dung to manure shed (110.46 ± 0.41), digging of land (111.49 ± 1.54), application of manure in the field (106.16 ± 0.57), sowing (109.71 ± 1.05), weeding (108.34 ± 1.17), harvesting (113.59 ± 0.24) and winnowing (115.48 ± 0.29). Moreover, preparation of organic manure (121.44 ± 4.65) was non-significant when related with transportation of organic manure to the field (119.56 ± 0.56). On the basis of classification of workload given by **Verghese (1994)** it was observed that preparation of organic manure was moderately heavy activity.

Percentage increase in heart rate over rest

During preparation of organic manure percentage increase in heart rate was 61.92 which highest from all other activities. The reason may be for moisten of manure, women farmers fetch water from far distances.

Transportation of organic manure to the field

Mean heart rate during rest (78.16 ± 1.30) was significantly ($p \leq 0.01$) lower than mean heart rate during work (119.56 ± 0.56). It was observed that mean heart rate during transportation of organic manure to the field was significantly

($p \leq 0.01$) higher (119.56 ± 0.56) than collection of cow dung from cattle shed (106.40 ± 0.89), transportation of cow dung to manure shed (110.46 ± 0.41), digging of land (111.49 ± 1.54), application of manure in the field (106.16 ± 0.57), sowing (109.71 ± 1.05), weeding (108.34 ± 1.17). Moreover it was also significantly ($p \leq 0.05$) higher than harvesting (113.59 ± 0.24). However, it was non-significant when related with preparation of organic manure (121.44 ± 4.65) and winnowing (115.48 ± 0.28).

Percentage increase in mean heart rate over rest

During transportation of organic manure to the field percentage increase in heart rate over rest was 52.96 which was higher from all other activities except from preparation of organic manure (61.92). The reason may be because women walked a lot along with 15 – 20 kg of load on their head.

Digging of land/seed bed preparation

Digging of land /seed bed preparation was classified as moderately heavy activity. Mean heart rate during rest (76.00 ± 0.96) was significantly lower than mean heart rate during work (111.49 ± 1.54). It was found that when digging of land was performed by women farmers means heart rate (111.49 ± 1.54) was significantly ($p \leq 0.01$) higher than collection of cow dung from cattle shed (106.40 ± 0.89) and it was significantly lower than preparation of organic manure (121.44 ± 4.65) and transportation of organic manure to the field (119.56 ± 0.56). Moreover, it was also significantly ($p \leq 0.05$) higher than application of manure (106.16 ± 0.57) in the field. However, it was non-significant when related to transportation of cow dung to manure shed (110.46±0.41), sowing (109.71 ± 1.05), weeding (108.34 ± 1.17), harvesting (113.59 ± 0.24).

Percentage increase in heart rate over rest

During digging of land percentage increase in heart rate over rest was 46.70 which was higher than collection of cow dung from cattle shed (41.56),

Plate 4 : Transportation of Organic Manure to the Field

Plate 5 : Digging of Land

transportation of cow dung to manure shed (45.34) and application of organic manure in the field (41.55).

Application of manure in the field

Application of manure in the field was moderately heavy activity. Mean heart rate during rest (75.00 ± 1.12) was significantly lower ($p \leq 0.01$) than mean heart rate during work (106.16 ± 0.57). When statistical comparison of mean heart rate during application of manure in the field was done it was observed that it was significantly ($p \leq 0.01$) lower (106.16 ± 0.57) than transportation of cow dung to manure shed (110.46 ± 0.41), preparation of organic manure (121.44 ± 4.56), transportation of organic manure to field (119.56 ± 0.56), harvesting (113.59 ± 0.24) and winnowing (115.48 ± 0.29). However, it was non-significant in relation to collection of cow dung from cattle shed (106.48 ± 0.89), sowing of seeds (109.71 ± 1.05) and weeding (108.34 ± 1.17).

Percentage increase in mean heart rate over rest

During application of manure in the field percentage increase in heart rate over rest was 41.55 which was lower than all other critical activities.

Sowing/transplanting of seeds

Sowing/transplanting of seeds was also moderately heavy activity. Heart rate during rest (75.00 ± 1.21) was significantly ($p \leq 0.01$) lower than mean heart rate during work (109.71 ± 1.05). When analysis of critical difference was done it was found that sowing was significantly ($p \leq 0.01$) lower (109.71 ± 1.05) than preparation of organic manure (121.44 ± 4.65), transportation of organic manure to the field (119.56 ± 0.65). Moreover, it was also significantly ($p \leq 0.01$) lower than winnowing (115.48 ± 0.29). However, it was non-significant in case of collection of cow dung from cattle shed (106.40 ± 0.89), transportation of cow dung to manure shed (110.46 ± 0.41), digging of land (111.49 ± 1.54), application of manure in the field (106.16 ± 0.57), weeding (108.35 ± 1.17) and harvesting (113.59 ± 0.24).

Percentage increase in heart rate over rest

During sowing / transplanting of seeds percentage increase in heart rate over rest was found to be 46.28. Findings of this study was supported by **Nag and Dutt (1980)** and **Shalini (2001)**.

Weeding

It was examined that weeding was moderately heavy activity. Mean heart rate during rest (75.00 ± 1.21) was significantly ($p \leq 0.01$) lower than mean heart rate during work (108.34 ± 1.17). When analysis of critical difference was done it was noted that heart rate during weeding was significantly ($p \leq 0.01$) lower than preparation of organic manure (121.44 ± 4.65), transportation of manure to the field (119.56 ± 0.56) and winnowing (115.48 ± 0.29). Moreover, it was also significantly ($p \leq 0.05$) lower than harvesting (113.59 ± 0.24). However, it was non-significant when compared to collection of cow dung from cattle shed (106.40 ± 0.89), transportation of cow dung to manure shed (110.40 ± 0.41), digging of land (111.49 ± 0.54), application of manure (106.16 ± 0.57) in the field and sowing (109.71 ± 1.05).

Percentage increase in heart rate over rest

During weeding percentage increase in heart rate over rest percentage increase in heart rate over rest was 44.46. Similar findings was found by **Shalini (2001), AICRP (2002)** and **Tewari et al (1991)**.

Harvesting

Harvesting was moderately heavy activity. Heart rate during rest (75.00 ± 1.21) was significantly ($p \leq 0.01$) lower than heart rate during work (113.59 ± 0.24). It was observed that heart rate during harvesting was significantly ($p \leq 0.01$) higher (113.59 ± 0.24) than collection of cow dung from cattle shed (106.40 ± 0.89), application of organic manure in the field (106.16 ± 0.57) and weeding (108.34 ± 1.17). Moreover, it was also significantly ($p \leq 0.01$) lower than preparation of organic manure (121.44 ± 4.65), transportation of manure to the field (119.56 ± 0.56) and winnowing (115.48 ± 0.29). However, it was non-

significant when related with transportation of cow dung to manure shed (110.46 ± 0.41), digging of land (111.49 ± 1.54), sowing (109.71 ± 1.45).

Percentage increase in heart rate over rest

During harvesting percentage increase in heart rate over rest was 51.46 which was higher from all other activities etc. preparation of organic manure (61.92), transportation of organic manure to the field (52.96) and winnowing (53.97) findings of this study was similar to **Shalini (2001)** and **AICRP (2002)**.

Winnowing

Winnowing was also moderately heavy activity. Heart rate during rest (75.00 ± 1.23) was significantly ($p \leq 0.01$) lower than heart rate during activity (115.48 ± 0.29). It was found that heart rate during winnowing was significantly ($p \leq 0.01$) higher (115.48 ± 0.29) than collection of cow dung from cattle shed (106.40 ± 0.89), transportation of cow dung to manure shed (110.46 ± 0.41), application of manure in the field (106.16 ± 0.57), sowing of seeds (109.71 ± 1.05), weeding (108.34 ± 1.17) and harvesting (113.59 ± 0.24). Moreover, it was also significantly ($p \leq 0.01$) lower than preparation of organic manure (121.44 ± 4.65). However, it was non-significant in case of digging of land (111.49 ± 1.54).

Percentage increase in heart rate over rest

During winnowing of paddy percentage increase in heart rate was 53.97 which was higher from all other activities except from preparation of organic manure in the field (61 12).

Thus, on the basis of this finding preparation of organic manure and transportation of manure to the field were more strenuous activities and application of manure in the field and collection of cow dung from cattle shed were least strenuous activities.

4.6.4 Energy Expenditure (kJ/min) Among Various Critical Activities Experienced by Women Farmer

As soon as physical work is performed, energy expenditure rises sharply. The greater the demands made on the muscles, the more the energy consumed. The increased consumption of energy associated with a particular activity expressed in work calories and is obtained by measuring energy consumption while working and subtracting from this the energy consumption during rest. This energy expenditure in K/Jules minutes indicate the level of bodily stress and in relation to heavy work they can be used to assess the rest periods, different ways of arranging work and compare the efficiency of different tools. Hence, energy expenditure should be used as a measure for strenuous physical effort rather than for mental activities.

Women farmers involved in organic farming have to perform various critical activities one after another. All these activities were found to be very heavy to extremely heavy on the basis of classification of workload given by **Verghese (1994)**. Therefore, in **table 4.23**, an attempt was made to calculate the energy expenditure (kJ/min) among various critical activities. It is described under following subheadings.

Collection of cow dung from cattle shed

On the basis of classification given by **Verghese (1994)** collection of cow dung from cattle shed was classified as very heavy activity. Energy expenditure during rest (3.22 ± 0.16) was significantly ($p \leq 0.01$) different from energy expenditure during work (8.10 ± 0.14). When one-way ANOVA test was applied and it was found that energy expenditure during collection of cow dung from cattle shed was significantly ($p \leq 0.01$) lower (8.18 ± 0.14) than preparation of organic manure (10.61 ± 0.73), transportation of organic manure to the field (10.29 ± 0.89), harvesting (9.39 ± 0.65) and winnowing (9.68 ± 0.46). Moreover, it was also significantly ($p \leq 0.05$) lower than digging of land / seed bed preparation (9.00 ± 0 24). However, it was non-significant in case of

Table 4.23 : Energy Expenditure Among Different Critical Activities Experienced by Women Farmers

Critical Activities	Energy expenditure (kiloJule/min)				
	EE during Rest Mean±S.E	EE at Work Mean±S.E	Increase Over Rest	% Increase Over Rest	Classification of Workload
Collection of cow dung from cattle shed	3.22 ± 0.16a	8.18 ± 0.14 acdeij	4.96	154.03	Very heavy
Transportation of cow dung to manure shed	3.36 ± 0.10b	8.84 ± 0.65 bcdj	5.48	163.09	Extremely heavy
Preparation of organic manure	3.20 ± 0.18c	10.61 ± 0.73 efghij	7 41	231 56	Extremely heavy
Transportation of organic manure to field	3.70 ± 0.20d	10.29 ± 0 89 defghi	6.59	178 10	Extremely heavy
Digging of land / seed bed preparation	3.36 ± 0.15e	9 00 ± 0.24 efacd	5 64	167 86	Extremely heavy
Application of manure in filed	3.20 ± 0.18f	8.15 ± 0 93 feıjcd	4.95	154 68	Very heavy
Sowing / transplanting of seeds	3.20 ± 0.19g	8.72 ± 0.16 gj	5 52	172 50	Very heavy
Weedıng	3.20 ± 0.19h	8.47 ± 0 18 hij	5 27	164.68	Very heavy
Harvestıng	3.20 ± 0.19ı	9 39 ± 0.65 ıacdfh	6.19	193 44	Extremely heavy
Wınnowıng	3.20 ± 0.19j	9.68 ± 0.46 jabcfgh	6 48	202 50	Extremely heavy

EE = Energy expenditure (kj / min.)

Increase over rest = EE at work - EE during rest

$$\% \text{ increase over rest} = \frac{\text{EE at work - EE during rest}}{\text{EE during rest}} \times 100$$

EE (kilojule/min) = [0.159 × Av. HR] - 8.72

HR = Heart rate (beats/min)

Mean value with different superscripts was significantly ($p \leq 0.01$) different from one another (on the basis of One-way ANOVA test).

transportation of cow dung to manure shed (8.84 ± 0.65), application of manure in the field (8.15 ± 0.93) and weeding (8.47 ± 0.18).

Percentage increase in energy expenditure over rest

During collection of cow dung from cattle shed percentage increase in heart rate over rest was 154.03 which was lowest from all other activities.

Transportation of cow dung to manure shed

It was observed that transportation of cow dung to manure shed was extremely heavy activity. Energy expenditure during rest (3.36 ± 0.10) was significantly ($p \leq 0.01$) higher than energy expenditure during work (8.84 ± 0.65). Critical analysis of difference indicated that energy expenditure during transportation of cow dung to manure shed was significantly ($p \leq 0.01$) lower than preparation of organic manure (10.61 ± 0.73), transportation of organic manure to the field (10.29 ± 0.89). Moreover, it was also significantly ($p \leq 0.05$) lower than winnowing (9.68 ± 0.46). However, it was non-significant when related to collection of cow dung from cattle shed (8.18 ± 0.14), digging of land (9.00 ± 0.24), application of manure in the field (8.15 ± 0.93), sowing (8.72 ± 0.16), weeding (8.47 ± 0.18) and harvesting (9.39 ± 0.65).

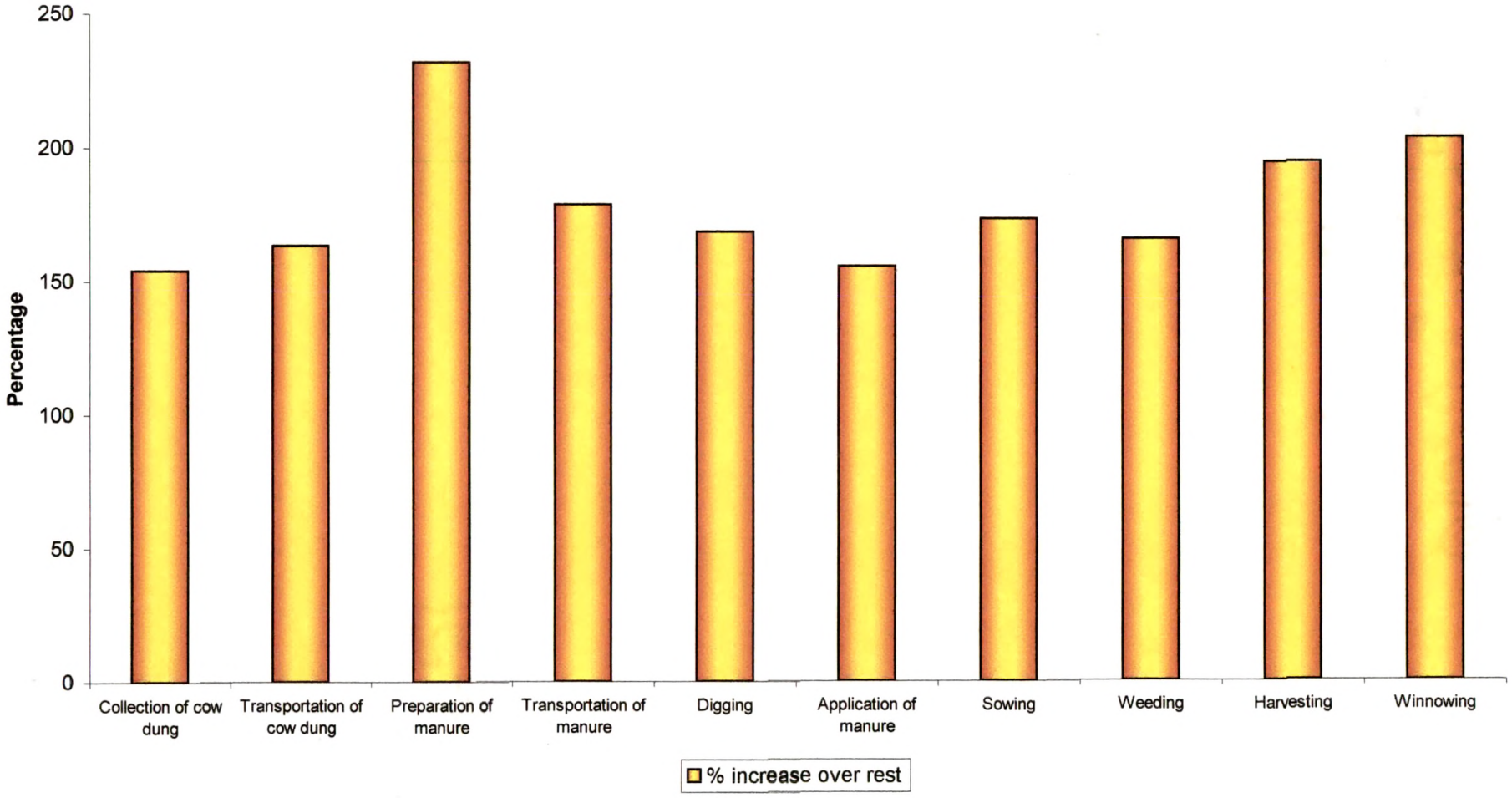
Percentage increase in energy expenditure over rest

During transportation of cow dung to manure shed percentage increase in heart rate over rest was 163.09. Therefore, it is considered extremely heavy activity.

Preparation of organic manure

It was examined that preparation of organic manure was classified as extremely heavy activity. Energy expenditure during rest (3.20 ± 0.18) was significantly ($p \leq 0.01$) higher than during work (10.61 ± 0.73). Statistical analysis of critical difference indicate that energy expenditure during preparation of organic manure was significantly higher than all other activities except transportation of organic manure to field (10.29 ± 0.89).

Fig. 4.4 Graphical Representation of Energy Expenditure (kj/min) of Women Farmers During Various Critical Activities



Percentage increase in energy expenditure over rest

During preparation of organic manure percentage increase in energy expenditure over rest was 231.56 which was highest when compared to all other activities.

Transportation of organic manure to the field

It was found that transportation of organic manure to the field was classified as extremely heavy activity. Energy Expenditure during rest (3.70 ± 0.20) was significantly ($p \leq 0.01$) higher than during work (10.29 ± 0.89). It was further observed that energy expenditure during transportation of organic manure to the field was significantly ($p \leq 0.01$) higher (10.29 ± 0.89) than collection of cow dung from cattle shed (8.18 ± 0.14), transportation of cow dung to manure shed (8.84 ± 0.65), digging of land (9.0 ± 0.24), application of manure in the field (8.15 ± 0.93) sowing (8.72 ± 0.16), weeding (8.47 ± 0.18) and harvesting (9.39 ± 0.65). However it was non-significant in case of preparation of organic manure (10.61 ± 0.73) and winnowing (9.68 ± 0.46).

Percentage increase in energy expenditure over rest

During transportation of organic manure to the field percentage increase in heart rate over rest was found to be 178.10. Therefore, it is considered to be extremely heavy activity.

Digging of land / seed bed preparation

It was noted that digging of land was extremely heavy activity. Energy expenditure during rest (3.36 ± 0.15) was significantly ($P \leq 0.01$) higher than during work (9.00 ± 0.24). Further analysis of critical difference showed that energy expenditure during digging of land was significantly ($p \leq 0.01$) higher (9.00 ± 0.24) than collection of cow dung from cattle shed (8.18 ± 0.14). Moreover it was also significantly ($p \leq 0.05$) higher than application of manure in the field (8.15 ± 0.93). However it was significantly ($p \leq 0.01$) lower than preparation of organic manure (10.61 ± 0.73) and transportation of manure to

the field (10.29 ± 0.89). It was non significant when related to transportation of cow dung to manure shed (8.84 ± 0.65), sowing (8.72 ± 0.16), weeding (8.47 ± 0.18), harvesting (9.39 ± 0.65) and winnowing (9.68 ± 0.46).

Percentage increase in energy expenditure over rest

During digging of land percentage increase in heart rate over rest was 167.86. Therefore, it is considered to be extremely heavy activity.

Application of manure in the field

Energy expenditure during rest (3.20 ± 0.18) was significantly lower than during work (8.15 ± 0.93). Statistical comparison found that energy expenditure during application of manure in the field (8.15 ± 0.93) was significantly ($p \leq 0.01$) lower than weeding (8.47 ± 0.18) and winnowing (9.68 ± 0.46). However it was non significant in case of collection of cow dung from cattle shed (8.18 ± 0.14), transportation of cow dung to manure shed (8.84 ± 0.65) sowing (8.72 ± 0.16) and weeding (8.47 ± 0.18).

Percentage increase in energy expenditure over rest

During application of manure in the field percentage increase in energy expenditure over rest was 154.68. Therefore, it was considered to be very heavy activity.

Sowing / transplanting of seeds

Energy expenditure during rest (3.20 ± 0.19) was significantly ($P \leq 0.01$) lower than during work (8.72 ± 0.16). It was observed that energy expenditure during sowing was significantly ($p \leq 0.05$) lower (8.72 ± 0.16) than winnowing (9.68 ± 0.46). However it was non significant when related to collection of cow dung from cattle shed (8.18 ± 0.14), transportation of cow dung to manure shed (8.84 ± 0.65), digging of land (9.0 ± 0.24), application of manure in the field (8.15 ± 0.93), weeding (8.47 ± 0 18) and harvesting (9.39 ± 0.65).

6a

6b

Plate 6a & 6b : Application of Manure in the Field

Percentage increase in energy expenditure over rest

During sowing of seeds percentage increase in energy expenditure over rest was found to be 172.50. Therefore, it was considered as very heavy activity.

Weeding

Energy expenditure during rest (3.20 ± 0.19) was significantly ($p \leq 0.01$) lower than during work (8.47 ± 0.18). Critical analysis of difference showed that energy expenditure during weeding was significantly lower (8.47 ± 0.18) than winnowing (9.68 ± 0.46). It was also significantly ($p \leq 0.05$) lower (8.47 ± 0.18) than harvesting (9.39 ± 0.65). However, it was non significant in relation to collection of cow dung from cattle shed (8.18 ± 0.14), transportation of cow dung to manure shed (8.84 ± 0.65), digging of land (9.00 ± 0.93) and sowing of seeds (8.72 ± 0.16).

Percentage increase in energy expenditure over rest

During weeding percentage increase in energy expenditure over rest was 164.68 which is considered to be very heavy activity.

Harvesting

Energy expenditure during rest (3.20 ± 0.19) was significantly ($p \leq 0.01$) lower than during work (9.39 ± 0.65). It was further observed that energy expenditure during harvesting was significantly ($p \leq 0.01$) higher (9.39 ± 0.65) than collection of cow dung from cattle shed (8.18 ± 0.14) application of manure in the field (8.15 ± 0.93) and weeding (8.47 ± 0.18). However, it was significantly ($p \leq 0.01$) lower (9.39 ± 0.65) than preparation of organic manure (10.61 ± 0.73) and transportation of manure to the field (10.29 ± 0.89). It was non-significant in case of transportation of cow dung to manure shed (8.84 ± 0.65), digging of land (9.00 ± 0.24) and sowing of seeds (8.72 ± 0.16).

Percentage increase in energy expenditure over rest

During harvesting percentage increase in energy expenditure was 193.44. Therefore, it was considered to be extremely heavy activity.

Winnowing

Energy expenditure during rest (3.20 ± 0.19) was significantly ($p \leq 0.01$) lower than during work (9.68 ± 0.46). It was observed that energy expenditure during winnowing was significantly ($p \leq 0.01$) higher (9.68 ± 0.46) than collection of cow dung from cattle shed (8.18 ± 0.14), application of manure to field (8.15 ± 0.93) sowing of seeds (8.72 ± 0.16) and weeding (8.47 ± 0.18). It was also significantly ($p \leq 0.05$) lower than preparation of organic manure (10.61 ± 0.73). However, it was non significant in relation to transportation of manure to field (10.29 ± 0.89), digging of land (9.00 ± 0.24) and harvesting (9.39 ± 0.65).

Percentage increase in energy expenditure over rest

During winnowing percentage increase in energy expenditure over rest was 202.50 which was highest from all other activities except preparation of organic manure 231.56. It was also considered as extremely heavy activity.

Thus, on the basis of energy expenditure preparation of organic manure was most strenuous activity and application of manure in the field was least strenuous activity.

4.6.5 Total Cardiac Cost of Work (TCCW) and Physiological Cost of Work (PCW)

Total cardiac cost of work (TCCW) and physiological cost of work were analysed and reported in table 4.24.

Collection of cow dung from cattle shed

It was observed that TCCW (721.07 ± 22.81) beats and PCW (47.90 ± 1.57) during collection of cow dung from cattle shed was significantly ($p \leq 0.01$) lower than that for preparation of organic manure (1149.13 ± 106.57 TCCW, 76.44 ± 7.00 PCW respectively), transportation of manure in the field (1101.00 ± 36.14 TCCW, 73.23 ± 2.49 PCW) digging of land (977.46 ± 44.72 TCCW, 65.16 ± 2.98 PCW) and winnowing (1132.20 ± 31.20 TCCW, 75.31 ± 2.17 PCW). However, it was non-significant in case of transportation of cow dung to manure shed (847.00 ± 37.86 TCCW, 54 50 ± 4.00 PCW), application of

Table 4.24 : Total Cardiac Cost Work (TCCW) and Physiological Cost of Work (PCW) Among Various Critical Activities Experienced by Woman Farmers

Critical Activities	TCCW & PCW				
	HR during Rest Mean ± S.E	HR during Work Mean ± S.E	HR during Recovery Mean ± S.E	TCCW Mean ± S.E	PCW Mean ± S.E
Collection of cow dung from cattle shed	75.16 ± 1.04	106.40±0.89	92.00	721.07±22.81 acdeij	47.90±1.57 acdeij
Transportation of cow dung to manure shed	76 ± 0.68	110.46±0.41	98.00	847.00±37.86 bcaij	54.50±4.00 bcdeij
Preparation of manure	75.00 ± 1.12	121.44± 4.65	105.17	1149.13±106 57 cefgh	76.44±7 00 cefgh
Transportation of manure to field	78.16 ± 1.30	119.56±0.56	110.17	1101 00±36.14 dfgh	73.23±2.49 dfgh
Digging of land / seed bed preparation	75.00 ± 1.12	106.16±0 57	93.97	977.46±44.72 eghj	65.16±2 98 eghi
Application of manure in field	76.00 ± 0.96	119.49±1.54	105.67	747.50±22 65 fcij	49.66±1 46
Sowing / transplanting of seeds	75.00 ± 1.21	109.71±1.05	90.00	745 78±19.61 gijcde	49.77±1 35 gij
Weeding	75.00 ± 1 21	108.34±1.17	94.84	797.65±62.57 hijedc	53 01±4.22 hij
Harvesting	75.00 ± 1.21	113.59±0 24	107.67	1068 90±44.92 iabfgh	71 09±3.04 i
Winnowing	75.00 ± 1 23	115.48±0.29	109 67	1132 20±31.20 jabefgh	75 31±2.17 j

HR = heart rate (beats / min.)

TCCW (Total cardiac cost work) = CCW + CCR

Where CCW = AWHR × duration
CCR = Ave. Recovery HR - Ave. Resting HR × duration

$$\text{Physiological cost of work (PCW)} = \frac{\text{TCCW}}{\text{Total time of work}}$$

manure in the field (747.50 ± 22.65 TCCW, 49.66 ± 1.46 PCW) and sowing (745.78 ± 19.61 TCCW, 49.77 ± 1.35 PCW).

Transportation of cow dung to manure shed

It was found that when transportation of cow dung to manure shed was done total cardiac cost of work (TCCW) and physiological cost of work (PCW) was significantly ($p \leq 0.01$) lower (847.00 ± 37.86 TCCW, 54.50 ± 4.00 PCW) than for preparation of organic manure (1149.13 ± 106.57 TCCW, 76.44 ± 7.00 PCW), transportation of manure to the field (1101.00 ± 36.14 TCCW, 73.23 ± 2.49 PCW), harvesting (1068.90 ± 44.92, 71.09 ± 3.04) and winnowing (1132.20 ± 31.20 TCCW, 75.31 ± 2.17 PCW). Moreover, physiological cost of work was also significantly ($p \leq 0.05$) lower (54.50 ± 4.00 PCW) than digging of land (65.16 ± 2.98). However, it was non-significant when related to collection of cow dung from cattle shed (721.07 ± 22.81 TCCW, 47.90 ± 1.57 PCW) application of manure in the field (747.50 ± 22.65 TCCW, 49.66 ± 1.46 PCW) and digging of land (977.46 ± 44.72 TCCW, 65.16 ± 2.98 PCW) and weeding (797.65 ± 62.57 TCCW, 53.01 ± 4.22 PCW).

Preparation of organic manure

Statistical comparison of critical difference among different activities indicated that when preparation of organic manure was done total cardiac cost of work (TCCW) and physiological cost of work (PCW) was significantly ($p \leq 0.01$) higher (1149.13 ± 106.57 TCCW, 76.44 ± 1.00 PCW) than digging of land (977.46 ± 44.72 TCCW, 65.16 ± 2.98 PCW), sowing (745.78 ± 19.61 TCCW, 49.77 ± 1.35 PCW) and weeding (797.65 ± 62.57 TCCW, 53.01 ± 4.22). Moreover, it was also significantly ($p \leq 0.05$) higher than application of manure in the field (747.50 ± 22.65 TCCW, 49.66 ± 1.46 PCW). However, it was non-significant in case of transportation of manure to the field (1101.00 ± 36.14 TCCW, 73.23 ± 2.49 PCW), harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 3.04 PCW) and winnowing (1132.20 ± 31.20 TCCW, 75.31 ± 2.17 PCW).

Transportation of Organic Manure to the Field

When critical analysis was done it was observed that TCCW and PCW during transportation of organic manure to the field were significantly ($p \leq 0.01$) higher (1101.00 ± 36.14 TCCW, 73.23 ± 2.49 PCW) than those for application of manure in the field (747.50 ± 22.65 TCCW, 49.66 ± 1.46 PCW), sowing (747.78 ± 19.61 TCCW, 49.77 ± 1.35 PCW) and weeding (797.65 ± 62.57 TCCW, 53.01 ± 4.22 PCW). However, it was non-significant in relation to preparation of organic manure (1149.13 ± 106.57 TCCW, 76.44 ± 7.00 PCW), digging of land (977.46 ± 44.72 TCCW, 65.16 ± 2.98 PCW), harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 3.04 PCW) and winnowing (1132.20 ± 31.20 TCCW, 75.31 ± 2.17 PCW).

Digging of land /seed bed preparation

It was found that total cardiac cost of work and physiological cost of work during digging of land /seed bed preparation were significantly ($p \leq 0.01$) higher (977.46 ± 44.72 TCCW, 65.16 ± 2.98 PCW) than for sowing of seeds (745.78 ± 19.61 TCCW, 49.77 ± 1.35 PCW) weeding (797.65 ± 62.57 TCCW, 53.01 ± 4.22 PCW). Moreover, it was significantly ($p \leq 0.01$) lower (977.46 ± 44.72 TCCW, 75.31 ± 2.17 PCW) than winnowing. However, it was non-significant when related to transportation of cow dung to manure shed (847.00 ± 37.86 TCCW, 54.50 ± 4.00 PCW), transportation of manure to the field (1101.00 ± 36.14 TCCW, 73.23 ± 2.49 PCW) and harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 3.04 PCW).

Application of manure in the field

When application of manure in the field was done it was found that total cardiac cost of work and physiological cost of work were significantly ($p \leq 0.01$) lower (747.50 ± 22.65 TCCW, 49.66 ± 1.46 PCW) than for digging of land (977.46 ± 44.72 TCCW, 65.16 ± 2.98 PCW) harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 3.04) and winnowing (1132.20 ± 31.20 TCCW, 75.31 ± 2.17 PCW) Moreover, physiological cost of work was also significantly ($p \leq 0.05$)

Figure 4.5a : Total Cardic Cost of Work

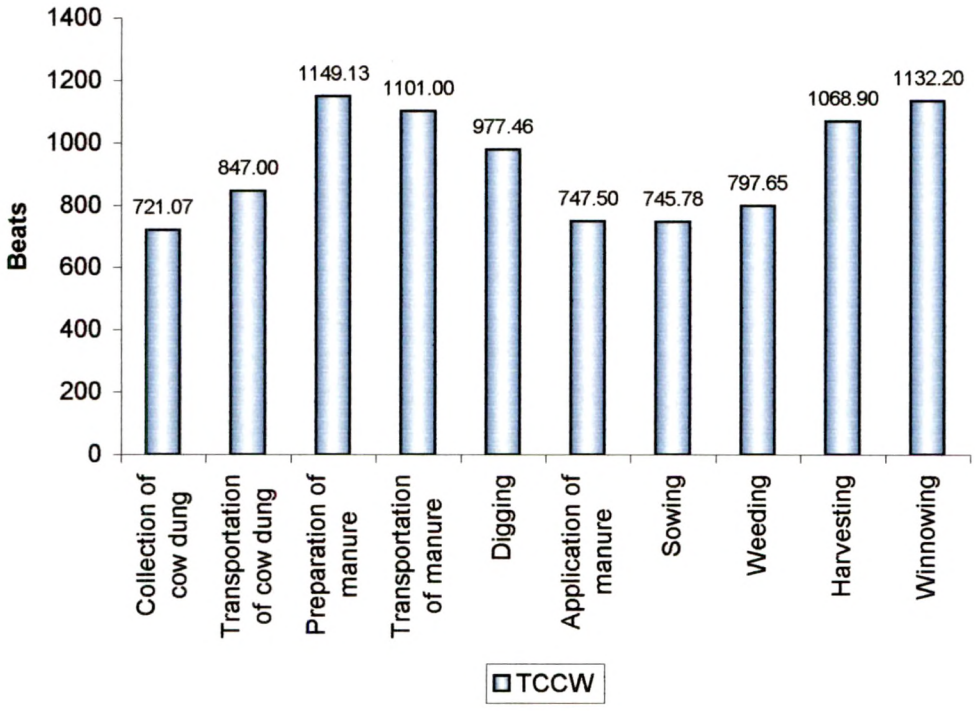
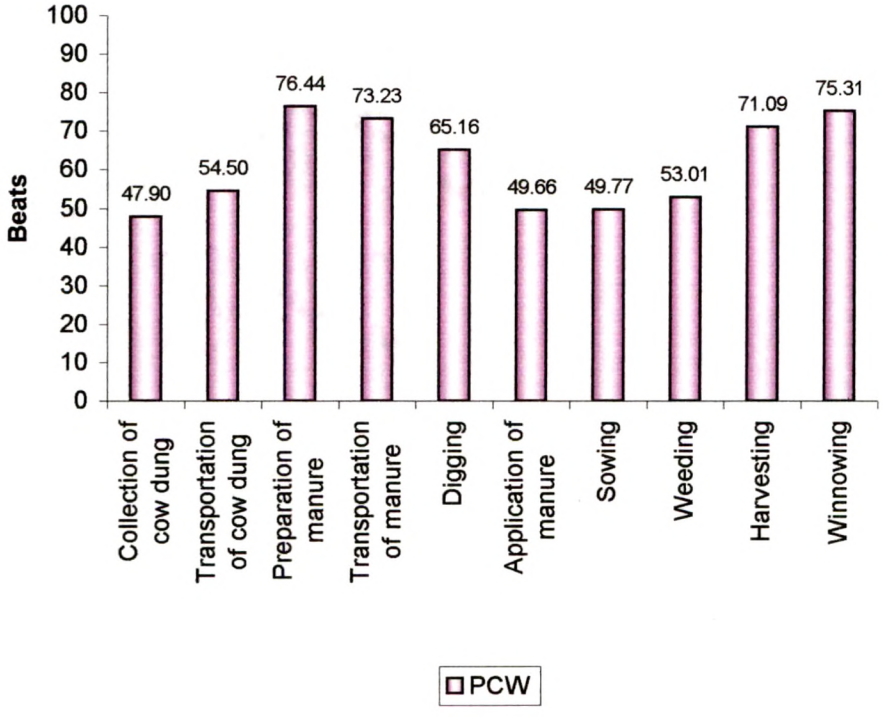


Figure 4.5b : Physiological Cost of Work



lower (49.66 ± 1.46) for weeding (53.01 ± 4.22). However, TCCW and PCW were non-significant in case of collection of cow dung from cattle shed (721.07 ± 22.81 TCCW, 47.90 ± 1.57 PCW), transportation of cow dung to manure shed (847.00 ± 37.86 TCCW, 54.50 ± 4.00 PCW) sowing of seeds (745.78 ± 19.61 TCCW, 49.77 ± 1.35 PCW) and weeding (7.97.65 ± 62.57).

Sowing / transplanting of seeds

It was examined that total cardiac cost of work and physiological cost of work during sowing / transplanting of seeds were significantly ($p \leq 0.01$) lower (745.78 ± 19.61 TCCW, 49.77 ± 1.35 PCW) than harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 2.17 PCW). However, it was non-significant in case of weeding (797.65 ± 62.57 TCCW, 53.01 ± 4.22 PCW).

Weeding

It was noted that total cardiac cost of work and physiological cost of work during weeding were significantly ($p \leq 0.01$) lower(797.65 ± 62.57 TCCW, 53.01 ± 4.22 PCW) than that for harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 3.04 PCW) and winnowing (1132.20 ± 31.20 TCCW, 75.31 ± 2.17 PCW). However, it was non-significant in relation to collection of cow dung from cattle shed (721.07 ± 22.81 TCCW, 47.90 ± 1.57 PCW) transportation of cow dung to manure shed (847.00 ± 37.86 TCCW, 54.50 ± 4.00 PCW) and sowing of seeds (745.78 ± 19.61 TCCW, 49.77 ± 1.35 PCW).

Harvesting

When harvesting was done total cardiac cost of work and physiological cost of work were significantly ($p \leq 0.01$) higher (1068.90 ± 44.92 TCCW, 71.09 ± 3.04 PCW) than for collection of cow dung from cattle shed (721.07 ± 22.81 TCCW, 47.90 ± 1.57 PCW) transportation of cow dung to manure shed (847.00 ± 37.86 TCCW, 54.50 ± 4.00 PCW), application of manure in the field (747.50 ± 22.65 TCCW, 49.66 ± 1.46 PCW) sowing of seeds (745 78 ± 19.61 TCCW, 49.77 ± 1.35 PCW) and weeding (797.65 ± 62.57 TCCW, 53.01 ± 4.22 PCW).

Plate 7 : Sowing of Seeds

Plate 8 : Weeding

However, it were non-significant in case of winnowing (1132.20 ± 31 20 TCCW, 75 31 ± 2.17 PCW).

Winnowing

It was found that total cardiac cost of work and physiological cost of work during winnowing were significantly ($p \leq 0.01$) higher (1132.20 ± 31.20 TCCW, 7531 ± 2.17 PCW) than all other activities except preparation of organic manure (1149.13 ± 106.57 TCCW, 76.44 ± 7.00 PCW) transportation of organic manure to the field (1101.00 ± 36.14 TCCW, 73.23 ± 2.49 PCW) and harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 3.04 PCW).

Thus, based on this finding preparation of organic manure was most strenuous activity and collection of cow dung from cattle shed was least strenuous activity.

4.6.6 Muscular Stress in Terms of Hand Grip Strength Experienced by Women Farmers

Women farmers in agriculture field perform manual activities i.e. collection of cow dung, transportation of cow dung to manure shed, preparation of organic manure etc. All these activities are critical activities. Muscular stress was prominent among these activities. Therefore, an attempt was made to measure the muscular stress (grip strength) of women farmers while performing various organic farming activities. The data (**Table 4.25**) is presented under following sub-headings.

Muscular stress (grip strength) during rest

Muscular stress (grip strength) before starting different activities was recorded. When one way ANOVA Test was applied it was found that grip strength for right hand during rest (18.50 ± 0.84) was significantly ($p \leq 0.05$) higher than all other activities. Further analysis of critical difference among various activities indicated that grip strength during rest (13.50 ± 1.33) for left hand was also significantly ($p \leq 0.05$) higher than all other activities.

Table 4.25 : Muscular Stress (grip strength) Among Different Critical Activities Experienced by Women Farmers

Critical Activities	Muscular Stress (kg)					
	Right hand			Left hand		
	Grip Strength (Mean ± SE)	Difference in mean grip strength	% Difference in mean Grip strength	Grip strength (Mean ± SE)	Difference in mean grip strength	% Difference in mean grip strength
Before activity (Rest)	18.50 ± 0.84	-	-	13 50 ±1 33a	-	-
After activity						
Collection of cow dung from cattle shed	17 84 ± 0 82 bgj	0.66	3.57	12 70±1 35	0 80	5 92
Transportation of cow dung to manure shed	18.08 ± 1 80 cdgj	0 42	2 27	12 75 ± 1 30	0 75	5 56
Preparation of org manure	15 50 ± 0 67 dc	3 00	16 22	11.00 ± 1 36	2 50	18 51
Transportation of org manure to field	17.33 ± 0.90 eg	1 17	6 32	12 31 ± 1 49	1 19	8 81
Application of manure in the field	17 75 ± 0 77 fg	0 75	4 05	12 50 ± 1 35	1.00	7 40
Digging of land	14 25 ± 0 85 ghik	4 25	22 97	9 66 ± 1 14	3 84	28 44
Sowing/ transplanting of seeds	17 70 ± 0.79 hg	0.80	4 32	12 66 ± 1 37	0 84	6 22
Weeding	17 36 ± 0.73 ig	1 14	6 16	11 08 ± 0 96	2 42	17 93
Harvesting	15 08 ± 0 89 jbc	3 42	18.48	9 83 ± 0 87	3 67	27 18
Winnowing	17 29 ± 0 76 kg	1.21	6 54	12 53 ± 1 37	0 97	7 18

Difference in grip strength = Grip strength at rest – Grip strength after work

$$\% \text{ Difference in grip strength} = \frac{\text{Grip strength at rest} - \text{Grip strength after work}}{\text{Grip strength at rest}}$$

Mean value with different superscripts was significantly ($p \leq 0.01$) different from one another (on the basis of One-way ANOVA test)

Muscular stress after performing various activities

Collection of cow dung from cattle shed

Mean grip strength after collection of cow dung from cattle shed both for right hand and left hand was 17.84 ± 0.82 and 12.70 ± 1.35 respectively. When statistical comparison of muscular stress after collection of cow dung was done, it was observed that grip strength after collection of cow dung for right hand was significantly ($p \leq 0.05$) higher (17.84 ± 0.82) than digging of land (14.25 ± 0.85) and harvesting (15.08 ± 0.89). Non-significant relationship was observed among mean grip strength for left hand after performing activity.

Percentage difference in mean grip strength

During collection of cow dung from cattle shed percentage difference in mean grip strength for right hand and left hand were recorded 0.357 and 0.80 respectively which means after performing this activity the grip strength for both hands were slightly decreased.

Transportation of cow dung to manure shed

When transportation of cow dung to manure shed was done mean grip strength of right hand after performing this activity was significantly ($p \leq 0.05$) higher (18.08 ± 1.80) than preparation of organic manure, digging of land in the field (14 25 ± 0.85) and harvesting (15.08 ± 0.89) which indicated that these activities were more strenuous than transportation of cow dung to manure shed. Non-significant relationship was observed with transportation of cow dung to manure shed for left hand and other activities.

Percentage difference in mean grip strength

Percentage difference in mean grip strength of right hand and left hand were 2.27 and 5.56 respectively which means after performing this activity grip strength of women farmers decreased upto certain extent

Preparation of organic manure

Statistical comparison of mean grip strength for right hand after preparation of organic manure was significantly ($p \leq 0.05$) lower (15.50 ± 0.67) than mean grip strength after transportation of cow dung to manure shed (18.08 ± 1.80) which indicated that preparation of organic manure was more strenuous activity than transportation of cow dung to manure shed. Non-significant relationship was observed among mean grip strength after preparation of organic manure by left hand and mean grip strength after performing other activities.

Percentage difference in mean grip strength

Percentage difference in mean grip strength both for right and left hand were recorded as 16.22 as 18.51 respectively which showed that preparation of organic manure was most strenuous activity.

Transportation of organic manure to the field

It was found that means grip strength of right hand after performing the activity of transportation of organic manure to field was significantly ($p \leq 0.05$) higher (17.33 ± 0.90) than mean grip strength after application of manure in the field (14.25 ± 0.85) which indicated that grip strength during digging of land decreased more as compared to transportation of organic manure to field. Mean grip strength after transportation of organic manure to field for left hand was non-significant when compared with all other activities.

Percentage difference in mean grip strength

Percentage difference in mean grip strength for for right hand and left hand were 6.32 and 8.81 respectively.

Digging of land

It was found that statistical comparison of mean grip strength of right hand after digging of land was significantly ($p \leq 0.05$) lower (14.25 ± 0.85) than application of manure in the field (17.70 ± 0.79) which indicated that digging of land is more strenuous activity as compared to application of manure in the

field. Non-significant relationship was observed among mean grip strength of left hand and all other activities.

Percentage difference in mean grip strength

Percentage difference in mean grip strength both for right hand and left hand were 22.97 and 28.44 respectively.

Application of manure in the field

Analysis of critical difference for application of manure in the field indicated that mean grip strength of right hand after application of manure in the field was significantly ($p \leq 0.05$) higher (17.70 ± 0.79) than mean grip strength during digging of land (14.25 ± 0.85). It means application of manure was less strenuous activity as compared to digging of land. Non-significant relationship was observed among mean grip strength after application of manure in the field for left hand (9.66 ± 1.14) and all other activities.

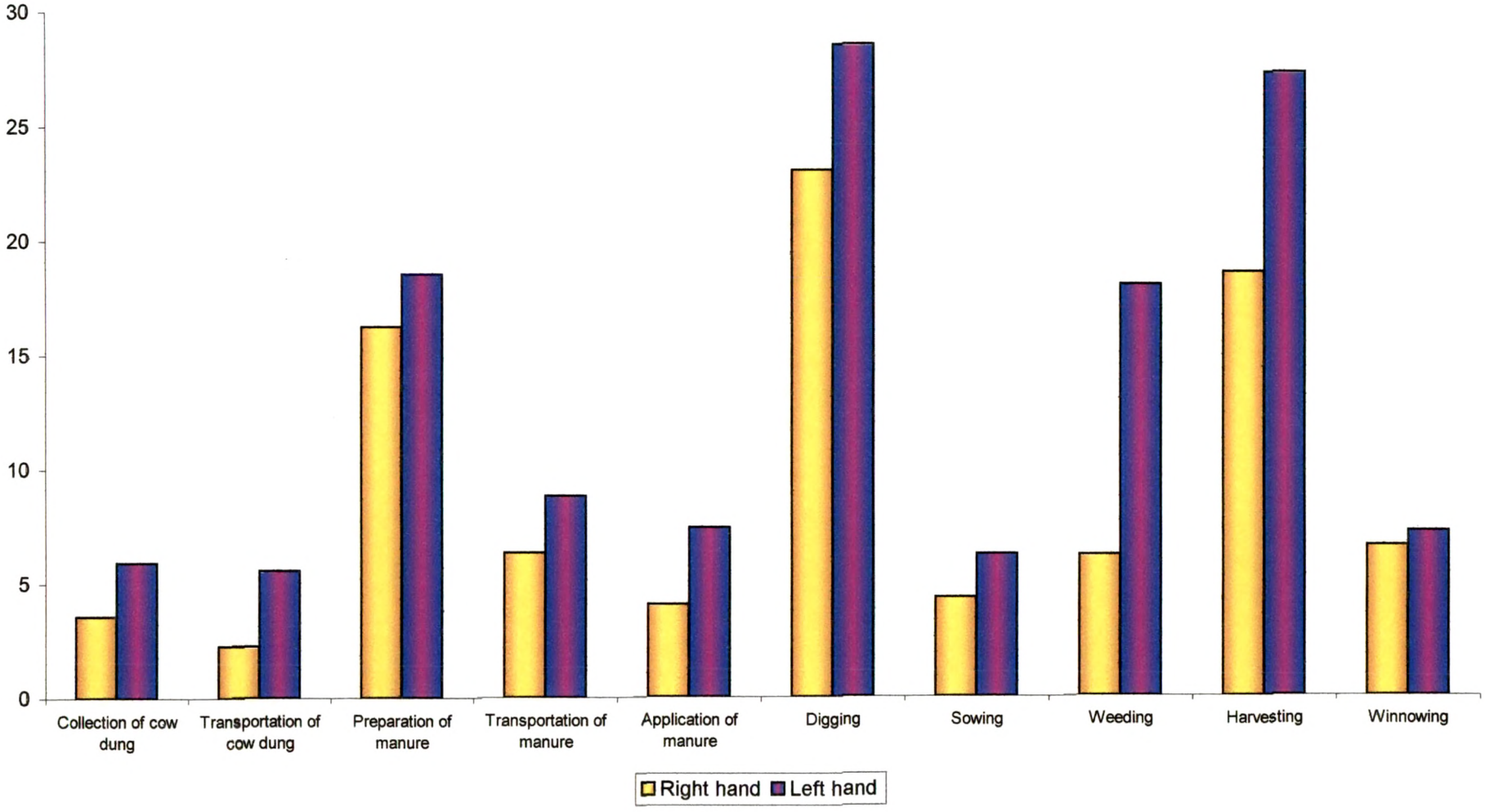
Percentage difference in mean grip strength

Percentage difference in mean grip strength during application of manure in the field both for right hand and left hand were 4.05 and 7.40 respectively which indicated that application of manure was less strenuous activity.

Sowing /transplanting of seeds

Statistical comparison of mean grip strength after sowing / transplanting of seeds for right hand was significantly ($p \leq 0.05$) higher (17.70 ± 0.79) than digging of land (14.25 ± 0.85) which indicated that grip strength after digging of land was higher as compared to muscular strength during sowing / transplanting of seeds. Non-significant relationship was observed among mean grip strength after sowing / transplanting of seeds for left hand and all other activities.

Fig. 4.6 Graphical Representation of Muscular Stress (kg) Experienced by Woment Farmers



Percentage difference in mean grip strength

Percentage difference in mean grip strength both for right hand and left hand were 4.32 and 6.22 respectively which indicated that sowing of seeds was less strenuous activity.

Weeding

Mean grip strength for right hand after weeding was significantly ($p \leq 0.05$) higher (17.36 ± 0.75) than mean grip strength after digging of land (14.25 ± 0.05). Non-significant relationship was observed among mean grip strength after weeding for left hand (11.08 ± 0.98) and all other activities.

Percentage difference in mean grip strength

Percentage difference in mean grip strength both for right hand and left hand were 6.16 and 17.93 respectively which indicate that weeding is less strenuous activity.

Harvesting

When harvesting was done mean grip strength of right hand was significantly ($p \leq 0.05$) lower (15.08 ± 0.89) than collection of cow dung from cattle shed (17.84 ± 0.82) and transportation of cow dung to manure shed. Non significant relationship was observed among mean grip strength harvesting of paddy for left hand (9.83 ± 0.87) and all other activities.

Percentage difference in mean grip strength

Percentage difference in mean grip strength both for right hand and left hand were 18.48 and 27.18 respectively.

Winnowing

Statistical comparison of mean grip strength after winnowing for right hand was significantly ($p \leq 0.05$) higher (17.29 ± 0.76) than digging of land (14.25 ± 0.85) which indicated digging of land was more strenuous activity as compared to winnowing. Non-significant relationship was observed among mean grip strength after winnowing for left hand ($12.53 \pm 1\ 37$) and all other activities.

Percentage difference in mean grip strength

Percentage difference in mean grip strength after winnowing both for right hand and left hand were 6.54 and 7.18 respectively. Thus from the findings it was clear that muscular stress experienced by women farmers both for right hand and left hand were highest during digging of land while it was lowest during transportation of cow dung to manure shed.

4.6.7 Work Rest Allowance Required for Various Critical Activities Performed by Women Farmers

Work rest allowance is a way of measuring fatigue and recovery or it is the way of measuring the physical workload of individual (**Muller, 1952**). After performing work the heart rate of women farmers increased and the time after which heart rate comes back to normal is called work rest allowance. Therefore for present study the time required for the subjects to come to resting heart rate was taken as rest allowance for the particular activity.

Work rest allowance required for women farmers among various critical activities were presented in **table 4.26** and discussed in following sub-heading.

Collection of cow dung from cattle shed

It was observed that when collection of cow dung from cattle shed was done the mean heart and mean energy expenditure were found to be 106.40 ± 0.89 beats/min and 8.18 ± 0.14 KJ/min Rest allowance needed for better performance of work was 2.3 ± 0.80 minutes.

Transportation of cow dung to manure shed

It was reported that when transportation of cow dung to manure shed was done mean heart rate and mean energy expenditure were 110.46 ± 0.41 beats/min and 8.84 ± 0.65 KJ/min. Therefore rest allowance required for better performance of work was 5.0 ± 0.28 minutes

Table 4.26 : Required Work Rest Allowance in Various Critical Activities Performed by Women Farmers

Critical Activities	Work rest allowance (minutes)		
	WRA (minutes) Mean ± S.E.	Heart rate during work	EE during work
Collection of cow dung from cattle shed	2.3 ± 0.80	106.40 ± 0.89	8 10 ± 1.14
Transportation of cow dung to manure shed	5.0 ± 0 28	110.46 ± 0.41	8.84 ± 0.65
Preparation of organic manure	10.00 ± 0.57 *	121.44 ± 4.65	10.61 ± 0.73
Transportation of manus to the field	10.00 ± 0.57	119.56 ± 0.56	10.29 ± 0.89
Digging of land / seed bed · preparation	8.0 ± 0 52	111.49 ± 1 54	9 00 ± 0.24
Application of manure in field	3 0 ± 0.37	106.16 ± 1 05	8 15 ± 0 93
Sowing / transplanting of seeds	4.0 ± 0 45	109 71 ± 1.05	8.72 ± 0 16
Weeding	6.0 ± 0.68	108.34 ± 1.17	8.47 ± 0.18
Harvesting	5 0 ± 0.63	113.59 ± 0.24	9 39 ± 0.65
Winnowing	4 0 ± 0.43	115.48 ± 0.29	9.68 ± 0.46

* This recommendation was when activity was performed for 15 minutes duration

Preparation of organic manure

It was noted that preparation of organic manure was strenuous activity. When it was performed by women farmers mean heart rate and mean energy expenditure were 121.44 ± 4.65 beats/min and 10.61 ± 0.73 Kj/min. Work rest allowance needed for better performance of work was 10.00 ± 0.57 minutes.

Transportation of manure to field

It was examined that when transportation of manure to field was done mean heart rate and mean energy expenditure of women farmer were 119.56 ± 0.56 beats /min and 10.29 ± 0.89 Kj/min therefore the work rest allowance needed for coming back of normal heart rate w as 10.00 ± 0.57 minutes.

Plate 9 : Harvesting

Plate 10 : Winnowing

Digging of land / seed bed preparation

When digging of land/seed bed preparation was done by women farmers mean heart rate and mean energy expenditure were 111.49 ± 1.54 beats/min and energy expenditure 9.00 ± 0.24 Kj/min. Work rest allowance required for avoiding fatigue was 8.00 ± 0.52 minutes.

Application of manure in field

It was found that when application of manure in the field was done mean heart rate and mean energy expenditure were 106.16 ± 1.05 beats/min and 8.15 ± 0.93 Kj/min. Therefore the work rest allowance needed for better performance of work was 3.0 ± 0.37 minutes.

Sowing / transplanting of seeds

When sowing/ transplanting of seeds was done by women farmers mean heart rate and mean energy expenditure were 109.71 ± 1.05 beats min-1 and 8.72 ± 0.16 kj/min.

Weeding

It was observed that when weeding was done by women farmers mean heart rate and mean energy expenditure were 108.24 ± 1.17 beats/min and 8.47 ± 0.18 kj/min. Therefore the work rest allowance required for better performance of work was 6.0 ± 0.68 minutes.

Harvesting

It was found that when harvesting was done by women farmers mean heart rate and mean energy expenditure were 113.59 ± 0.24 beats/min, 9.39 ± 0.65 Kj/min respectively. Therefore work rest allowance needed for better performance of work was 5.0 ± 0.63 minutes.

Winnowing

It was observed that when winnowing was done by women farmers mean heart rate and mean energy expenditure were 115.48 ± 0.29 beats/min and 9.68 ±

0.46 kj/min. The work rest allowance needed for reducing the work load was 4.00 ± 0.43 minutes.

Thus, based on this finding maximum rest allowance was required for preparation of organic manure and transportation of manure to the field and minimum for collection of cow dung from cattle shed.

Rank Order of Selected Critical Activities Based on Different Parameters

Table 4.27 : Rank Order of Critical Activities on the Basis of Different Parameters

Critical Activities	Rank Order						Total Rank Order
	HR	EE	TCCW	PCW	Grip Strength		
					R	L	
Collection of cow dung from cattle shed	9	9	10	10	9	9	9 33
Transportation of cow dung to manure shed	6	6	6	6	10	10	7 33
Preparation of organic manure	1	1	1	1	3	3	1 67
Transportation of organic manure to field	2	2	3	3	5	5	3.33
Digging of land / seed bed preparation	5	5	5	5	1	1	3 67
Application of manure in the field	10	10	8	9	8	6	8 50
Sowing / transplanting of seeds	7	7	9	8	7	8	7 67
Weeding	8	8	7	7	6	4	6 67
Harvesting	4	4	4	4	2	2	3 33
Winnowing	3	3	2	2	4	7	3.50

- Total rank = Sum of rank of all parameters / Total no. of parameters
- HR – Heart rate, EE - Energy Expenditure, R – Right hand, L – Left hand

Table 4.27 presents rank order of various critical activities on the basis of different parameters selected for the present study. On over all basis drudgery faced by women farmers while performing all critical activities in descending rank order were as follows – preparation of organic manure, transportation of manure to the field, harvesting, winnowing, digging of land, weeding, transportation of cow dung to manure shed, sowing of seeds, application of

Plate 11 :
Measurement of Blood pressure

Plate 12 :
Measurement of Distance Traveled

Plate 13 : Measurement of Muscular Strength

manure in the field and collection of cow dung from cattle shed. Therefore, on overall basis it was observed that preparation of organic manure was most strenuous activity and collection of cow dung from cattle shed was least strenuous activity.

During preparation of organic manure women farmers fetched water using bucket from far distances because of non-availability of water near manure shed. During preparation of organic manure women farmers performed combination of tasks viz. collection of cow dung from manure shed, making different layers of heap frequently, therefore combination of several tasks was one of the reason that workload was highest during this activity. This finding is supported by **Straker, (1997)**. They spent long hours and continuously carried out lot physical efforts in standing cum bending posture for making compost. Moreover, time spent, distance travelled and physical efforts involved by women farmers in collection of cow dung from cattle shed was least as compared to other activities. This may be the reason that collection of cow dung from cattle shed ranked least on overall parameters.

Remedial Measures for Reduction of Work Load Experienced by Women Farmers in Various Critical Activities

On the basis of findings of the present study following remedial measures could be suggested.

1. Women farmers could take rest pause in between and after performing different critical activities. Rest pause may vary according to the critical activity as recommended in **table 4.26**.
2. A booklet entitled "Ergonomically Tested Tools and Technologies for Hill Women Involved in Organic Farming" is prepared by the investigator this booklet contained various tools and technologies developed by various institutions and could be available at low cost. By adopting those tools and technologies during various critical activities work load experienced by women farmers can be reduced.

SECTION VII

Testing of Hypotheses

A number of hypotheses were formulated on the basis of objectives of the study. For the purpose of statistical analysis the hypotheses were formulated in null form.

Ho_1 There is no relationship between attitude of women farmers regarding organic farming and their personal family and situational variables.

Personal variables

Age of women farmers

Educational level of women farmers

Family variables

Size of the family

Size of land holding

Situational variables

Number of livestock

Years of experience in organic farming

Co-efficient of correlation was computed to test this hypothesis

Personal variables

Non-significant relationship was observed between age, educational level and attitude of women farmers regarding organic farming (**Table 4.28**). Thus, null hypothesis was accepted in this case. It could be concluded that age, educational level of women farmers did not affect their attitude regarding organic farming.

Table 4.28 : Co-efficient of Correlation Between Attitude of Women Farmers Regarding Organic Farming and their Selected Variables

Variables	Attitude	df	Level of Significance
	r - value		
Personal Variables			
Age	0.027	118	Non-significant
Educational level	0.069	118	Non-significant
Family Variables			
Size of family	-0.252	118	0.05
Size of landholding	0.429	118	0 01
Situational Variables			
Number of livestock	0.272	118	0.01
Years of experience	-0.35	118	Non-significant

Family variables

Negative co-relation was observed between size of family and attitude of women farmers regarding organic farming which showed that as the size of family increased, positive attitude of women farmers towards organic farming decreased and vice versa.

A positive correlation was observed between size of land holding and attitude of women farmers regarding organic farming which reflected that greater the size of land holding more favourable would be the attitude of women farmers regarding organic farming. **(Table 4.28)**

Situational variables

A positive correlation was observed between number of livestock and attitude of women farmers regarding organic farming (**Table 4.28**) which showed that

greater the number of livestock more positive would be the attitude of women farmers regarding organic farming.

Non-significant relationship was found between years of experience regarding organic farming and attitude of farmers. Thus, null hypothesis was accepted in this case.

Thus, it could be concluded that attitude of women farmers regarding organic farming is affected by size of family, size of land holding and number of livestock possessed by women farmers.

Ho_2 There is no relationship between body discomfort experienced by women farmers and their personal, family and situational variables.

Personal variables

Age of women farmers

Educational level of women farmers

Family variables

Size of the family

Size of land holding

Situational variables

Number of livestock

Years of experience in organic farming

Co-efficient of correlation was computed to test this hypothesis

Table 4.29 : Co-efficient of Correlation Between Body Discomfort Experienced by Women Farmers and their Selected Variables

Variables	Body Discomfort	df	Level of Significance
	r - value		
Personal Variables			
Age	-0.504	118	Non-significant
Educational level	0.269	118	0 01
Family Variables			
Size of family	-0 057	118	Non-significant
Size of landholding	-0.004	118	Non-significant
Situational Variables			
Number of livestock	-0.148	118	Non-significant
Years of experience	-0.238	118	0.01

Personal variables

Non-significant relationship was observed between age of the women farmers and body discomfort experienced by them.

A positive co-relation was observed between educational level of women farmers and body discomfort experienced by them. Thus, it could be inferred that as the educational level of women farmers increased, body discomfort experienced by them also increased. The reason may be due to high educational level, women farmers did not like to perform agricultural activities.

Family variables

Non-significant relationship was observed between size of family, size of land holding of women farmers and body discomfort experienced by them. (**Table 4.29**) Thus, in this case null hypothesis was accepted. Thus, it could be concluded that family variables of women farmers did not affect body discomfort experienced by them.

Situational variables

Non-significant relationship was observed between number of livestock possessed by women farmers and body discomfort experienced by them. Thus, null hypothesis was accepted in this case. It could be concluded that number of livestock possessed by women farmers did not affect body discomfort experienced by them.

A negative relationship was found between years of experience in organic farming and body discomfort experience by women farmers **(Table 4.29)** Thus, it could be concluded that although this women farmers were having body discomfort due to poor technologies, poor posture and long working hours but they were not conscious about them. Moreover they were used to for their work.

Ho_3 There is no relationship between age, standing height, body weight of women farmers and following selected variables namely.

Physical fitness index (PFI)

Aerobic capacity (Vo_2 max ml/kg min)

Body type (Ponderal index)

Heart rate (beats/min)

Energy expenditure (KJ/min)

Co-efficient of correlation was computed to test this hypothesis.

Table 4.30 Co-efficient of Correlation Between Age, Standing Height, Body Weight of Women Farmers and their Selected Variables

Variables	Age			Standing height			Body weight		
	r value	df	LOS	r value	df	LOS	r value	df	LOS
PFI	-0 579	4	NS	-0.523	4	NS	-0 322	4	NS
Vo_2 Max	0 850	4	0 05	-0 206	4	NS	-0 373	4	NS
PI	0 480	4	NS	0 067	4	NS	0 901	4	0 05
Heart rate	a) 0 979	4	0 01	d) 0 850	4	0 05	f) –0 846	4	0 05
	b) 0 970	4	0 01						
Energy expenditure	a) 0 982	4	0 01	d) 0 850	4	0 05	d) –0 845	4	0 05
	c) 0 953	4	0 01						
	d) 0 973	4	0 01						
	e) 0 950	4	0 01						

- LOS = Level of significance
- NS = Non-significant

a) Transportation of cow dung to manure shed
b) Application of manure in the field
c) Transportation of manure to the field
d) Digging of land
e) Winnowing
f) Sowing of seeds

Age and selected variables

When co-efficient of correlation was applied between age and heart rate of women farmers (**Table 4.30**) while performing various critical activities viz. collection of cow dung from cattle shed, transportation of cow dung to manure shed, preparation of organic manure, transportation of organic manure to field, digging, application of manure in the field, sowing, weeding, harvesting and winnowing, a positive correlation was observed between age and heart rate of women farmers while transportation of cow dung to manure shed and application manure in the field and for other activities non-significant

relationship was observed. Thus, it could be concluded that as the age of women farmers increased their heart rate also increased during collection of cow dung from cattle shed and application of manure in the field.

It was observed that when co-efficient of correlation was applied between age and energy expenditure of women farmers while performing various critical activities, a positive correlation was observed between age and energy expenditure of women farmers while transportation of cow dung to manure shed, transportation of manure to the field, digging and winnowing. For other activities non-significant relationship was found. Thus, it could be concluded that as the age of women farmers increased their energy expenditure also increased for particular activities. **(Table 4.30)**

Standing height and selected variables

. When co-efficient of correlation was applied between standing height and heart rate among various critical activities performed by women a positive correlation was observed during digging of land. For other activities this relation was found to be non-significant. Thus, it could be inferred that heart rate of tall women farmers increased more during digging of land as compared to short women. (**Table 4.30**).

A positive correlation was observed between standing height and energy expenditure of women farmers during digging of land. For other activities this relationship was found to be non-significant Thus, it could be concluded that as energy expenditure among tall women farmers was more during digging of land as compared to short women farmers.

Body weight and selected variables

When co-efficient of correlation was applied between body weight and heart rate of women farmers while performing various critical activities, a negative correlation was observed during sowing of seeds. For other activities this relationship was found to be non-significant. Thus, it could be concluded that heart rate among women farmers having more weight was more during

sowing of seeds than women farmers with less body weight and vice versa. Further, a negative correlation was observed between body weight and energy expenditure of women farmers during digging of land which indicated that as the body weight of women farmers increased their energy expenditure during digging of land decreased and vice-versa. But for other activities this relationship was found to be non-significant

Ho_4 There is no relationship between heart rate and energy expenditure of women farmers while performing selected critical activities.

Co-efficient of co-relation was computed to test this hypothesis.

Table 4.31 : Co-efficient of Co-relation Between Heart-rate and Energy Expenditure While Performing Selected Critical Activities

Critical Activities	Heart rate & Energy Expenditure	df	Level of significance
Collection of cow dung from cattle shed	0 997	4	0 01
Transportation of cow dung to manure shed	0 999	4	0 01
Preparation of organic manure	0 988	4	0 01

When co-efficient of co-relation was applied between heart rate and energy expenditure of women farmers while performing selected activities viz. Collection of cow dung from cattle shed, transportation of cow dung to manure shed, preparation of organic manure, transportation of organic manure to the field, digging of land, application of manure, sowing, weeding, harvesting and winnowing. Out of these activities a positive co-relation was found between heart rate and energy expenditure of women farmer during collection of cow dung from cattle shed, transportation of cow dung to manure shed and preparation of organic manure.

Thus, null hypothesis was partially accepted. It could be concluded that as the heart rate of women farmers while performing certain activities increased there energy expenditure for those activities (**Table 4.31**) also increased.

Ho_5 There is no relationship between total cardic cost of work (TCCW) and physiological cost of work (PCW) of women farmers while performing selected critical activities.

Co-efficient of correlation was computed to test this hypothesis.

Table 4.32 : Co-efficient of Co-relation Between Total Cardic Cost of Work (TCCW) and Physiological Cost of Work (PCW) While Performing Various Activities

Critical Activities	TCCW & PCW r - value	df	Level of Significance
Collection of cow dung from cattle shed	0.995	4	0 01

Co-efficient of co-relation was applied between total cardic cost of work (TCCW) and physiological cost of work (PCW) of women farmers while performing various activities. A positive co-relation was observed between total cardic cost of work (TCCW) and physiological cost of work during

collection of cow dung from cattle shed. But for other activities this relationship was found to be non-significant. Thus, null hypothesis was partially accepted. It could be concluded that as the total cardic cost of work of women farmers increased their physiological cost of work during collection of cow dung from cattle shed was also increased.

Ho_6 There is no difference between heart rate and energy expenditure of women farmers before and while performing various critical activities.

Simple t-test was applied to find out the critical difference between heart rate and energy expenditure before and while performing various activities.

Heart-rate

t- value (**Table 4.33**) revealed that there was significant difference between mean score of heart rate before and while performing various activities. Thus, null hypothesis was rejected. It could be inferred that there is difference in heart rate of women farmers before and while performing various critical activities.

Energy expenditure

t- value (**Table 4.33**) revealed that there was significant difference between mean score of energy expenditure before and while performing various activities. Thus, null hypothesis was rejected. It could be inferred that there is difference in energy expenditure of women farmers before and while performing various critical activities.

Table 4.33 : t- value Showing Difference Between Heart-rate and Energy Expenditure Before and While Performing Various Activities

Critical activities	Heart rate		Energy expenditure		df	Level of significance
	Mean score	t- value	Mean score	t- value		
Collection of cow dung from cattle shed						
At rest	75.16	22.65	3.22	22.54	10	0 01
During work	106.40		8.18			
Transportation of cow dung to manure shed						
At rest	76.00	43 10	3 36	42 95	10	0 01
During work	110 47		8 84			
Preparation of organic manure						
At rest	75.00	9.68	3 20	9.74	10	0 01
During work	121.44		10.61			
Transportation of manure						
At rest	78.16	29.16	3.70	29 24	10	0.01
During work	119.57		10.29			
Application of manure						
At rest	75.00	24.89	3 20	24.44	10	0 01
During work	106.16		8.15			
Digging						
At rest	76.00	19.47	3 36	19.46	10	0 01
During work	111.49		9.00			
Sowing						
At rest	75.00	21.59	3.20	21.54	10	0.01
During work	109.71		8.72			
Weeding						
At rest	75.00	19 77	3.20	19.86	10	0.01
During work	108.34		8.47			
Harvesting						
At rest	75 00	31.21	3.20	30.26	10	0 01
During work	113.59		9.39			
Winnowing						
At rest	75 00	32 07	3 20	31 85	10	0 01
During work	115.81		9 68			

Ho_7 There exist no variation in the heart rate, energy expenditure, total cardic cost of work (TCCW), physiological cost of work (PCW), grip strength and work rest allowance of women farmers while performing various activities.

One-way ANOVA test was computed to test this hypothesis.

Table 4.34 : One-way ANOVA Test for Calculating Variation in Selected Parameters for Women Farmers

Parameters	df	Sum of Square	Mean Square	F – value	Level of Significance
Heart rate					
Between groups	9	1495 00	166 10	9 75	0.01
Within groups	50	851 20	17.02		
Energy expenditure					
Between groups	9	38.72	4.30	10.02	0.01
Within groups	50	21 47	0.42		
TCCW					
Between groups	9	16500 00	183300 00	12 52	0 01
Within groups	50	7315.00	14630.00		
PCW					
Between groups	9	7474.00	830.50	11.72	0 01
Within groups	50	3542.00	70 84		
Grip strength					
Right hand					
Between groups	9	119.20	13.24	2.41	0.05
Within groups	50	274.10	5.48		
Left hand					
Between groups	9	79.44	8.82	0.90	Non-significant
Within groups	50	488.90	9.77		
Work rest allowance					
Between groups	9	406.40	45 16	31.27	0 01
Within groups	50	72.19	0 14		

Significant variation was observed in heart rate, energy expenditure, total cardic cost of work (TCCW), physiological cost of work (PCW), grip strength for right hand and work rest allowance while performing various activities. **(Table 4.34)**

For left hand grip strength of women farmers while performing various activities was non-significant. Thus, null hypothesis was accepted in this case. Therefore it could be concluded that there exist variation in heart rate, energy expenditure, total cardic cost of work (TCCW), physiological cost of work (PCW), grip strength for right hand and work rest allowance among various activities performed by women farmers. For finding, the amount of variation among different activities for selected parameters, there detailed tables could be referred. **(Table 4.22, 4.23, 4.24, 4.25 & 4.26)**

SECTION VIII

4.8 Discussion of Findings

Major findings in relation to interrelationship of the variables studied are discussed below

Attitude of Women Farmers Regarding Organic Farming

The results of the present study indicated that about half of the farmers had favourable attitude towards organic farming and less than half of them had neutral attitude towards it. Moreover, very few of them had unfavourable attitude. The reason may be that organic farming was one of the oldest practice of India but due to revolution of pesticides and chemicals many farmers shifted to chemical farming in the hope of more production from land which in turn resulted into deterioration of soil fertility, soil erosion, heavy demand of water for irrigation. But now again organic farming is adopted by several farmers because it is safe and healthy farming.

Data presented in table (**Appendix II**) indicated that majority of farmers agreed that crop produced by applying organic manure require less amount of water and majority of farmers agreed with the fact that quality of crop produced by the use of organic manure is high. Findings showed that less than half of the farmers had neutral attitude towards organic farming the reason may be that although these farmers had knowledge regarding advantages of organic farming but still in order to enhance their production which in return increased their income they used chemicals in a very negligible amount. Thus, they were having neutral attitude towards organic farming. Moreover, a very negligible percentage of farmers had unfavourable attitude towards organic farming. The reason may be that their income, educational level and size of land holding was very low and their main aim was to get maximum production so that they could earn maximum profit income. Thus, they used chemicals in high amount By the usr of organic fertilizers yield of crop increased after 2 – 3 years but poor farmers could not wait for long period. They want immediate production to

increase their income, which lead to unfavourable attitude towards organic farming.

Further, when interrelationship between personal, family and situational variables were analyzed, it was observed that age, educational level and occupation of farmers does not affect their attitude regarding organic farming. The reason may be that due to *Gramin Krishi Vikas Samiti* and several other NGO's these farmers were aware regarding advantages of organic farming regardless of their age, educational level and occupation. Thus non-significant relationship was observed between these variables. Further, negative co-relation was observed between size of family and attitude of farmers regarding organic farming which showed that as the size of family increased, favourable attitude towards organic farming decreased and vice – versa. This might be due to the fact that greater size of family leads to greater expenditure on household and other activities demanded greater income which lead to application of high doses of chemicals for high production thus unfavourable attitude towards organic farming. Further a positive co-relation was observed between size of land holding and attitude of women farmers towards organic farming which reflected that as the size of land holding increased farmers had a positive attitude towards organic farming. The reason may be that greater size of land holding leads to greater monthly income which in turn motivate the farmers to adopt organic farming. Further, a positive co-relation was observed between number of livestock and attitude towards organic farming. The reason may be due to more livestock they get large amount of cow dung by which they could prepare large amount organic manure. Thus they had positive attitude towards organic farming.

Time Expenditure Pattern of Women Farmers

Women have been delegated more and more arduous, monotonous and time and energy consuming agricultural operation Improper working postures (prolonged bending, squatting), long work schedules and strenuous working conditions leaves little or no time for leisure or rest and have proved

detrimental to the welfare of the rural women (**National perspective plan of women, 1980; Devi, 1982; Blyn, 1983 and Patel, 1984**). Studies conducted on time use pattern of rural women have reported that women spend 10 – 15 hours per day in various household chores, water and fuel collection, animal care, pre harvest and post harvest work (**Sandhu, 1972; Charkarvarty, 1975; Saxena and Bhatnagar, 1985; Strivastava, 1985 and Singhal, 1989**). From the findings of the present study it was revealed that harvesting was most time consuming activity (480 minute) which was followed by winnowing (360 minutes), weeding (360 minutes), digging of land, transplanting of seeds, application of manure in the field (180 minutes) etc. This finding is supported by **Kaur (1988), Grover and Verma (1993).**

Type of Technologies Used by Women Farmers

From the findings, it could be concluded that technologies used by them were not very efficient. Moreover, they were not ergonomically designed. Most of them were traditional which were followed by one generation to another generation. Beside this posture adopted by them during all critical activities were faulty, mainly they performed all the activities in squatting cum bending or standing cum bending posture which lead to lots of workload during these agricultural operations. Lack of access to new or ergonomically designed, gender based technologies resulted into drudgery in various agricultural operation performed by women farmers. This finding is supported by **Bhattacharyajee (1995) and Borah (1995).**

Body Discomfort

Conceptually, discomfort is a risk indicator as it uses the body's own feedback system to detect possible problems. Possible sources of discomfort resulting from musculo-skeletal stress include : tension in muscles, nerves, blood vessels, ligaments and joint capsules, compression of the some tissues, local chemical changes associated with muscles fatigue, local chemical changes related to restricted blood flow and partial ischemia, disruption of nerve

condition resulting from pressure. Thus, body discomfort is a valuable variable for ergonomists to assess the physical match between worker and their work. **(Straker, 1999)**. To adequately describe discomfort four aspects need to be covered i.e. intensity, quality, location and temporal pattern Measurement of the intensity of discomfort has usually been attempted by asking the worker to rate the intensity on a scale commonly termed as a subjective scale Various subjective rating scales are followed such as **Borg's scale (1970), Corlett and Bishop (1976)** scale and **visual analogue discomfort** (VAD) scale. Quality refers to different nouns to be used by the workers Location of discomfort is commonly collected either through the use of a body map or by specific reference to body part Temporal pattern of discomfort is often measured by collecting information about discomfort at different times. From the findings, it was revealed that more than one third of women farmers (41.67 per cent) experienced severe body discomfort during work while 42.50 per cent experienced moderate body discomfort and only 15.33 per cent reported no body discomfort during work. The reason may be that due to long working hours they experienced severe body discomfort. Moreover, magnitude of pain was high among marginal women farmers as compare to other groups of women farmers the reason may be due to poor socio-economic conditions their health was not good beside this due to lower income group marginal women farmers were hired by large farmers. This finding is supported by **AICRP (2000).** When relationship between body discomfort and educational level was computed, positive relationship ($p \leq 0.01$) was observed which indicate that as the educational level of women farmer increase body discomfort experienced by them also increased The reason may be due to high level of education they don't like to perform monotonous agricultural activities.

CardioVascular Stress

For a long time the literature has been describing attempts to express the workload in terms of heart rate. Heart rate is a valuable measure of strain index **(Kirk and Sullman, 2001).** For the present study heart rate of women farmers was recorded before and during work in various critical activities It was observed that significant increased in heart rate was observed before and during work Heart rate was highest during preparation of organic manure (121 44 ± 4.65 b/min) followed by transportation of manure to the field (119 56 ± 0 56), harvesting of paddy (113 59 ± 0 24) and winnowing (115 48 ± 0.29). It was lowest during application of manure in the field (106.16 ± 0.57). It was observed from findings that heart rate was significantly ($p \leq 0.01$) affected by the age during transportation of cow dung to manure shed and application of manure in the field Beside this heart rate was also affected by standing height and body weight of women farmer. A positive relationship was observed during standing height and heart rate of women farmers during digging of land/seed bed preparation which indicated that cardio-vascular stress among taller women farmers was more as compared to shorter women. A negative correlation was observed between heart rate during sowing of seeds ($p \leq 0.05$) and body weight of women farmers which indicated that as the weight of the women farmers increased the cardio-vascular stress experienced by them decreased and vice-versa

Further when co-efficient of correlation between heart rate and energy expenditure was computed it was observed that significant ($p \leq 0\ 05$) relationship was found between heart rate and energy expenditure which indicated that as the heart rate (cardio vascular stress) of women farmers

increased their energy expenditure also increased. This finding was supported by the findings of **Nag and Dutt (1980); Joshi (1985)**; and **Rama (1990).**

Energy Expenditure

Heavy work in any activity resulted into greater physical exertion and is characterised by a high energy consumption and severe stress on the heart and lungs. Energy consumption and cardiac capacity set limits to the performance of heavy work and these two functions are often used to assess the degree of severity of a physical work. **(Grandjean, 1971)**. As soon as physical work is performed, energy consumption rises sharply. The greater the demands made on the muscles by one occupation the more the energy consumed. The increased consumption associated with a particular activity expressed in work calories or kilojule. These work calories indicate the level of body stress. Hence, energy expenditure should be used as a measure of comparison only for strenuous physical efforts and never for studying mental activities or skilled work. **Lehmann, (1953)** reported that an agricultural labourer's daily energy consumption was 4200 kcal/day. Many researches have shown that a healthy occupation should involve a daily energy consumption of 3000 - 3500 kcal for a man, with 2500 - 3000 kcal for women. From the findings of the present study it was observed that energy expenditure during preparation of organic manure (10.61 ± 0.73) was highest followed by transportation of manure to field (10.21 ± 0.89) and lowest during application of manure in the field (8.15 ± 0.93). On the basis of classification of workload with reference to energy expenditure all the critical activities varies form very heavy to extremely heavy. From the findings it was observed that significant ($p \leq 0.01$) relationship was found between age and energy expenditure during transportation of cow dung to manure shed which reflected that as the age of the women farmers increased, their energy expenditure in various activities also increased.

When co-efficient of correlation was applied between body weight and energy expenditure during sowing of seeds it was observed that negative correlation

was found which showed that as the weight of the women farmers increased their energy expenditure during sowing decreased and vice-versa.

Further, when relationship between height and energy expenditure of women farmer was observed positive relationship ($p \leq 0.01$) was found which showed that as the height of the women farmer increased their energy expenditure while performing various activities also increased.

Total Cardiac Cost of Work (TCCW) and Physiological Cost of Work (PCW)

Total cardiac cost of work (TCCW) is the sum of cardiac cost of work i.e. heart rate recorded during work and cardiac cost of recovery i.e. heart rate recorded after performing activity. Thus total cardiac cost of work gives a clear picture of total cardiac stress experienced by women farmers. Further physiological cost of work is measured by total cardiac cost of work divided by total time of work. From the findings it was revealed that total cardiac cost of work and physiological cost of work were significantly ($p \leq 0.01$) highest during preparation of organic manure (1149.13 ± 106.57 TCCW, 76.44 ± 7.00 PCW) followed by transportation of manure to the field (1101.00 ± 36.14 TCCW, 73.23 ± 2.49 PCW) harvesting (1068.90 ± 44.92 TCCW, 71.09 ± 3.04 PCW). It was lowest during collection of cow dung from cattle shed (721.07 ± 22.81 TCCW, 47.90 ± 5.57 PCW).

Muscular Stress (grip strength)

Researches reviewed indicated that grip strength after performing manual work decreased. **Agarwal and Sharma (2003), Singh and Sharma (2003)** indicated that grip strength of women after performing repetitive manual task like peeling, cutting, cooking of fruits and vegetables, digging of land, weeding, and harvesting decreased. Finding of the present study revealed that grip strength for right hand after performing various critical activities was significantly decreased but for left hand non-significant relationship was observed. The reason may be because all the activities mainly digging of land,

weeding, harvesting were performed by right hand. Further, muscular stress was highest during digging of land. The reason may be during the digging of land women continuously putting pressure on hands, which would resulted into lot of muscular stress. Moreover, muscular stress was lowest during transportation of cow dung to manure shed. The reason may be during this activity women farmers spent less muscular efforts.

Work Rest Allowance

The problem of fatigue and rest pause is of great practical importance demanding a high degree of physical effort. Heavy manual work, if continued for long period, results in fatigue due to production of lactic acid and its accumulation in the active tissues, which are the main causative factors for physiological fatigue. In order to relieve from it, rest pause is needed otherwise efficiency of worker and their output will be greatly affected.

When the workload in a given task exceeds the allowable limit and its duration is not properly punctuated by adequate rest pause, a progressive increase in physiological reaction is observed with time. The rest pause is therefore, essential for such a task. Of course it depends on the intensity of the physical effort and its duration. The findings of the present study showed that activities like transportation of organic manure to field, preparation of organic manure followed by digging of land/seed bed preparation required maximum rest allowance. The reason may be that during these activities heart rate become increased. In order to bring back the increased heart rate to normal condition work rest allowance is required so that the workload of women farmers become reduced and their efficiency to do work become increased. This finding is supported by **Shalini (2000).**

Conclusion

Thus, based on discussion, it could be concluded that work load (in terms of body discomfort, cardio-vascular stress, energy expenditure etc.) experienced by women farmers in various activities was high.