METHODOLOGY

CHAPTER III

METHODOLOGY

The detailed sequential procedure followed to study the Ergonomic assessment of workload in critical activities of women farmers involved in organic farming is as shown below -

3.1 Research Design

3.2 Conceptual Framework of the Study

3.3 Variables Under Study

3.4 Operational Definitions

3.5 Selection of the Sample

3.6 Development of the Instrument

3.8 Method of Data Collection

3.9 Analysis of Data

3.1 Research Design

Research design is the systematic approach followed to study a problem. A descriptive cum experimental research design was used for the present study. Descriptive research design was used to find out type of critical activities performed by the women farmers, type of technologies used, time spent and distance travelled by them. Beside this agricultural information like type of organic manure, types of pesticides used by them etc. were also collected. Experimental research design was used to test the physical fitness of women farmers in terms of standing height, body weight, aerobic capacity etc. Beside this workload in terms of heart rate (Cardio-vascular stress), energy expenditure

and muscular stress (grip strength) experienced by women farmers were also measured.

3.2 Conceptual Framework of The Study

Conceptual frame work of the study was discussed in following two subheadings

Conceptual framework of the descriptive Study: It is conceptualized that attitude of women farmers regarding organic farming was direct function of their personal, family and situational variables. It was further proposed that body discomfort experienced by women farmers among various activities was also affected by their personal, family and situational variable. **(Fig. 3.1a)**

Conceptual framework of experimental study: It is conceptualized that workload in terms of cardio-vascular stress, muscular stress, energy expenditure was affected by type of critical activities performed by women farmers, time spent and distance travelled by them. Beside this it is also assumed that physical fitness index, age, aerobic capacity, standing height, body weight and pondural index of women farmers also affect the workload experienced by them. It is further proposed that by introducing work rest allowance workload of women farmers can be reduced **(Fig.3. 1b)**

3.3 Variables of The Study

A variable is any characteristic that varies across people or situations that can be of different levels or types. The variables selected for the present study along with the rationale for selecting these variables have been presented in the following two sub headings

Fig. 3.1a Conceptual Framework of Descriptive Study

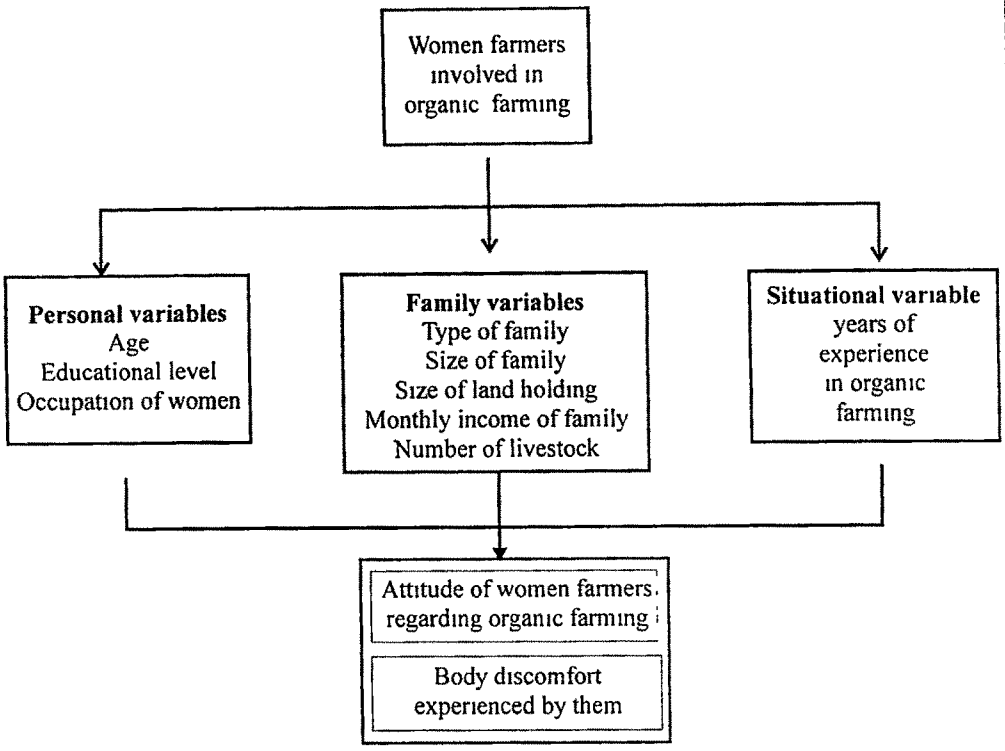
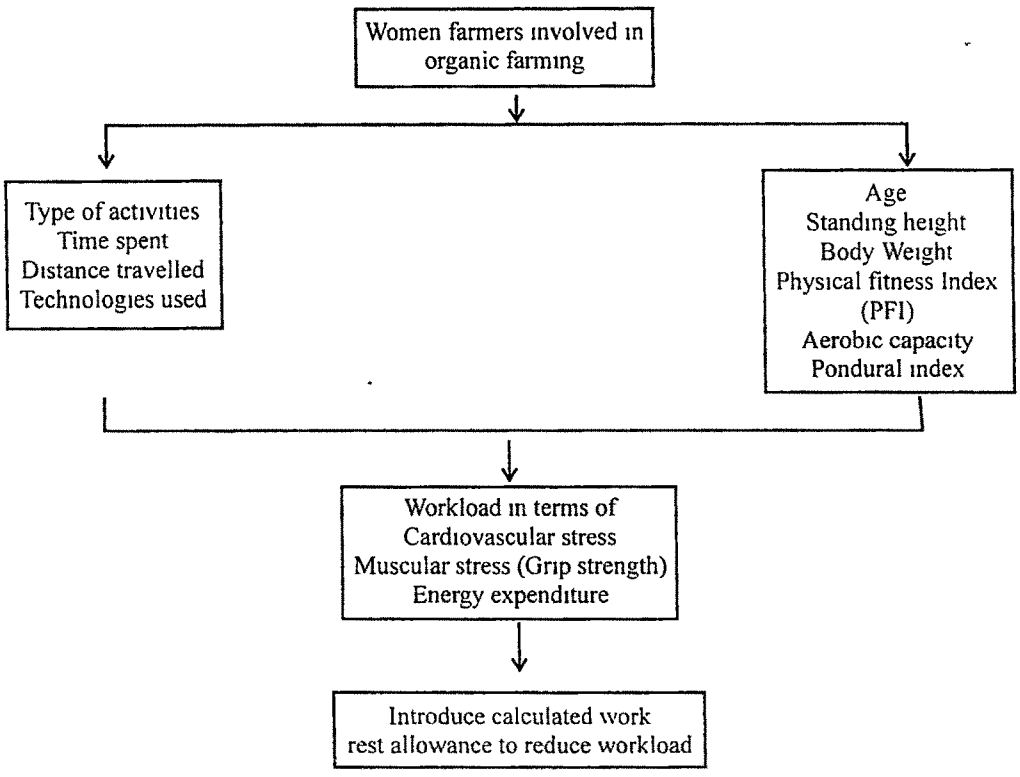


Fig. 3.1(b) Conceptual Framework of Experimental Study



Hypothetical relationship of variables for descriptive work: It is assumed that personal variables i.e. age, educational level and occupation of farmer; family variables i.e. size of family, size of land holding and number of live stock and situational variable i.e. years of experience, affects the attitude of women farmers regarding organic farming. Beside this body discomfort experienced by women farmers may be affected by their personal, family and situational variables. (**Fig.3. 2a**) A detailed discussion of variables selected for descriptive study were as follows

Dependent variables

Attitude of women farmers regarding organic farming: Attitude has been defined as the degree of positive or negative effect associated with some psychological object. **(Thurston, 1929)** It is assumed that attitude of women farmers regarding organic farming may be affected by personal, family and situational variables. The literature reviewed provides evidence that there exists dearth of information regarding this variable. Thus it was considered to be an important variable in the present investigation.

Body discomfort : Body discomfort is the pain experienced by women farmers. It is the situation, which brings about disharmony and disorders in the life of the individual. It is a situation where a worker has no control and finds herself/himself incompatible to function satisfactorily on his/her own. The researches reviewed (**Vishwanathan and Jaffery, 1990**); **Gulati, 1991; Francis, 1992; Nair, 1992; and Selvarani, 1992**) showed that occupation accounts for most of the illness in the workers. Among the work-related body discomforts are headache, backache, lumber pain, wrist pain, forearm pain, limb pain etc. Studies conducted by **Shalini (2000); Singh (2000)** indicated that body discomfort were very common among women involved in farming. **Sharma (1995)** reported that occupational health problems like strain on shoulders due to strenuous working posture, pain in hips, neck and back discomfort, headache due to long work duration, pain in shoulders due to

Fig.3. 2a Hypothetical Relationship of Variables for Descriptive Data

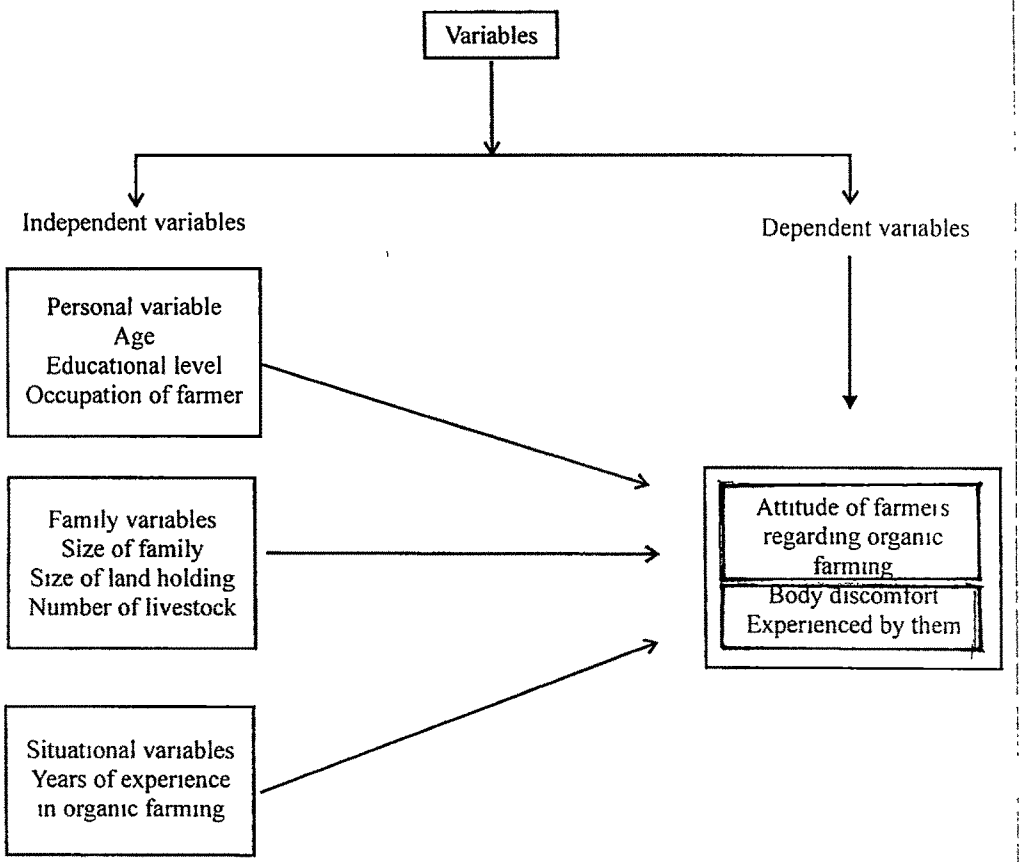
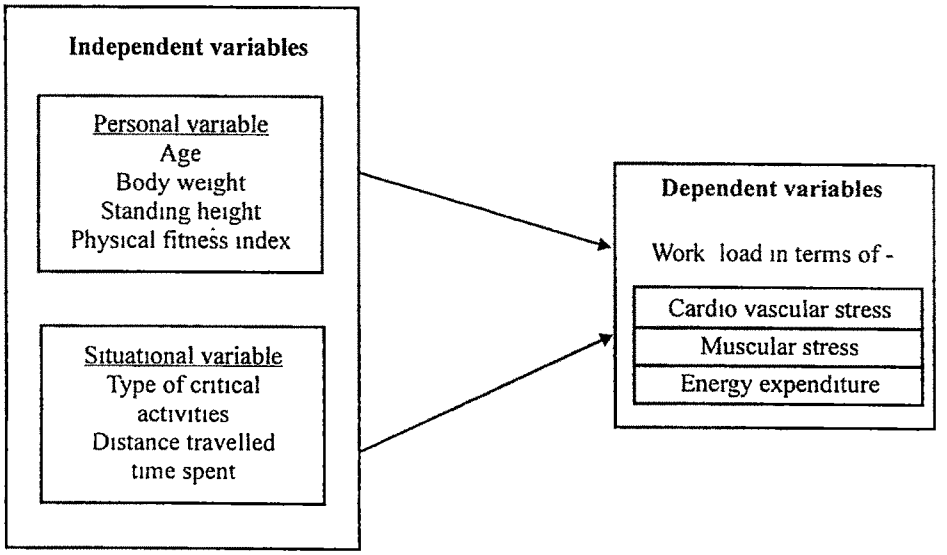


Fig.3.2b Hypothetical Relationship of Variables for Experimental Data



repetitious work movement, pain in hands, fingers and arms were very common among women workers involved in carpet weaving. Literature reviewed showed that body discomforts during various agricultural activities are major issue therefore to explore this variable and its authenticity investigator was interested to find out the body discomfort experienced by women farmers involved in organic farming.

Independent variables

Personal variables : Age, Educational level and occupation of women farmers were considered personal variables for descriptive study.

Family Variables : Family variables included size of family, size of land holding and number of livestock.

Situational variable : Situational variables include years of experience in organic farming.

Personal variables

Age: Age was considered an important variable affecting the body discomfort/health problems experienced by women involved in various occupations. The studies showed that body discomfort/health problems were found to be more among older women as compare to younger one involved in construction work, food processing industries and agricultural labour (**Shalini, 2000; Singh 2000; Agarwal, 2002**), Age of the homemaker was considered to be an important variable influencing task performance (**Sandhu, 1976; Kaur, 1986; Singhal, 1989**). The studies showed that with the increase in age, times spent on household and agricultural activities decreased and vice- versa. On the basis of size of land holding it was also found that body discomfort experienced by marginal women farmers were more as compared to large farmers (**Shalini, 2000**). Moreover, it was assumed that age also affects attitude of women farmers regarding organic farming. However, literature reviewed showed dearth

of information regarding this relationship. Hence, it was considered essential to investigate its relation with attitude as well as body discomfort in various activities for the present study.

Educational level : Education as a variable has been investigated by many research workers for its influence on various improved practices. As organic farming was one of the oldest practice in India but due to revolution of pesticides and chemical fertilizers people shifted to chemical farming but now the situation has changed. In Uttranchal majority of women farmers were involved in organic farming therefore it is necessary to find out the impact of educational level on attitude of women farmers regarding organic farming. Moreover, it was observed that educational level also affect body discomfort/health problems experienced by women farmers. Some studies showed higher the educational level, lower would be health problems. Because educated workers easily adopted improved practices of work therefore they had less health problems (**Singh and Singh, 1970; Patel and Singh 1972and Borah 1991**). Hence it was thought to be appropriate to include educational level as an independent variable for the present study.

Family variable

Size of family : Size of family was considered important variable affecting the attitude and body discomfort experienced by women farmers. Lack of literature exploring the influence of size of family regarding attitude and body discomfort experienced by women farmers, inspired the investigator to incorporate this variable in the present study. However, family size was found to be associated with the time used pattern of women in various farm, livestock and income generating activities. (**Sharma and Singh, 1970; Puri, 1971, Grewal, 1980; Kamalamma, 1981; Devi,1984**) Hence size of family was taken as an independent variable for the descriptive study

Size of land holding: Size of land holding plays a significant role in time spent by women in livestock and farm activities (**Munjal, 1984and Agarwal, 1988**). Time spent in various task was observed to decrease with increase in land holding size (**Saxena and Bhatnagar, 1985; Gandhi, 1986**). Therefore, it was assumed that size of land holding also affects body discomfort experienced by women farmers. Moreover, there was dearth of information regarding attitude of women farmers regarding organic farming and size of land holding. Hence the investigator was interested in finding out its relationship with attitude regarding organic farming.

Number of livestock : It is assumed that number of livestock might be having an effective association with attitude of women farmers regarding organic farming. Because more the number of livestock, more would be the time spent in livestock activities which might lead to body discomfort experienced by women farmers. **Jain, 1980; Dey, 1981 and Singhal, 1989** reported that number of livestock affects the time used pattern of women farmers. It is also proposed that increased number of livestock, lead to increased organic animal waste. Therefore, favourable attitude towards organic farming. However, there was dearth of information regarding this variable therefore, investigator was interested to study the effect of this variable.

Family income: Family income as an important variable has been investigated by several researcher. Significant association was found to be established between time use patter and family income (**Bafna, 1979; Sandhu, 1985, Jain, 1986; Singal, 1989**). However **Bafna (1979)** reported an inverse relationship between in come and time use pattern. Few researches have indicated that hours of productive work increased when a person's family income became smaller (**Farouq, 1980.** Women of the household of high income group participated less in agricultural work (**Devi and Reedy, 1987**) The investigator was hence wanted to investigate the strength of this variable in the descriptive study

Situational variable

Years of experience : Years of experience in organic farming is also believed to play significant role in relation to attitude regarding organic farming and body discomfort experienced by them. But, lack of evidences as regards to the relationship between attitude, body discomfort and years of experience regarding organic farming have been found which motivated the investigator to find out the direction of this variable in the descriptive study.

Hypothetical relationship of variables for experimental work: For the present study age, body weight, standing height, physical fitness index, aerobic capacity, pondural index are personal variables which affect the workload in terms of cardio-vascular stress, muscular stress (grip strength), energy expenditure experienced by them. Beside this type of critical activities, time spent and distance traveled in these activities also affect the workload experienced by women farmers. (**Fig.3. 2b**) A detailed discussion of variables used for experimental study was as follows

Dependent variable

Dependent variable is the behavioural measurement made by the experimenter or in other words. It is the outcome, which has been predicted to be dependent on the independent variables. The following dependent variable was selected for the experimental study.

Workload: Workload was the dependent variable. Workload refers to the amount of efforts put in by an individual while performing given task. Workload in terms of cardio - vascular stress, energy expenditure and muscular stress (grip) was affected by several factors and it is postulated that a variety of personal variables such as age, standing height, body weight and physical fitness index, situational variables such as type of activities , time spent and distance travelled in different activities would have a direct affect on workload experienced by women farmers. Some of the effects of the introduction of

improved technologies, work rest allowance and work methods on workload in terms of heart rate (cardio vascular stress), energy expenditure have been found out by **Winter et al. (1985), Sharma (1996), Borah (1995), Shalini (2000)**and **Singh (2000)**. Still there is dearth of information regarding workload experienced by women farmers in organic farming activities. Hence it was essential to investigate the workload in relation to other variables taken in the study.

Independent variables

Independent variables are those variables which the researcher can manipulate or controls or in other words independent variables are those variables whose effect the researcher is interested. The following independent variables were selected for the experimental work:

Personal variables : Personal variables consisted of age, standing height, body weight, physical fitness index of women farmers

Situational variables : Situational variable include type of activities, time spent and distance travelled in different activities.

A critical analysis of available literature have been presented with special reference to workload in terms of cardio vascular stress, energy expenditure and muscular stress (grip) in the following discussion.

Personal variables

Age of women farmers: Age of the women farmers was considered to be an important variable influencing workload of women farmers. **AICRP (1999); Sharma et al(1999); Agarwal(2001); AICRP(2000-2001)**

Few studies showed that heart rate and energy expenditure during weeding activity was more (108.78 beats/min) among middle age group (31-40 years) as

compared to younger age group (21-30 yrs) i.e. 107.90 beats/min and 8.54 kj/min (**AICRP, 2000-2001**) Similarly grip strength after performing various food processing activities was reduced more among older age group (36-45 yrs) as compared to younger age group (16-25 yrs) **Agarwal, 2001**.Age also affects the participation of women in different agricultural activities. A few studies have reported that time spent on agricultural activities decreased with increase in age (**Singh and Singh, 1981, Singal, 1989**). Beside this age is an important variable causing variability in the anthropometric measurements. (**Sumangala (1995), Stoudt (1981)** found the decrease in the number of body dimensions between the ages of 18 and 74 years. As women grow older their length measurements decreases while girth increases. Due to these physical changes, physique of elder women differs from younger women **O' Brien(1941)**. Age had a negative relationship with standing heights of workers. (**Sumangala, 1995**).

Standing height of women farmers : It is the height of the individual when standing in erect position by stretching the arm straight down and heels together touching the ground. It is the measurement of vertical distance from vertex to floor. It is an important variable, which affects the workload of women farmers. Few researches indicate that as the number of children increases the standing height measurement decreases **Sumangala (1995)**. **O' Brien (1941)** reported that unmarried women were thin and weighed least. Women married without children are the tallest of the groups. Women having a number of children are the shortest and heaviest with the largest girth measurement. She further reported that when all adult women are considered irrespective of their marital status, the correlation between height and girths are lower for women inin only particular age group **Shahnawaz and Davies, 1977, Croneg, 1980, Pheasant, 1982** and **Boussena and Davies (1987)** reported that knowledge of anthropometric dimensions such as height, weight is an important requisite for the design of equipment, work space and work place layout. **Hanspal (1985)** reported the height of the person at 5th , 50th and 95th percentile were found to

be 150.00cm, 154.20cm and 160.00cm respectively. **Varghese et. al. (1989)** found the mean height of housewives was 153.20cm. Further the height at 5th and 95th percentile value was 143.50 and 162.60cm. **Nag 1986, Varghese et. al. 1989**, justified that the wide variations in the ranges for each dimension could be attributed to the ethnic bias as well as to the nutritional status. Thus, height is an important variable which may affect workload of women farmers. Shrinkage in height in older people has also been noted (**Molen Brock, 1987**). This shrinkage is mainly due to biological changes that take place as a part of the normal aging process.

Body weight : Body weight of woman farmer may affect the work load experienced by her. There was dearth of information regarding this variable. However, few studies indicated that weight of women farmer affect their work load (**Phillips, 1954; Banerjee and Saha 1970, Bleigberg, 1980; Murayama and Ohtsuka, 1999**). Therefore, the investigator was interested in effect of this variable.

Physical fitness index : Physical fitness index is an important parameter for measuring the health of women farmers which in turn affect the workload in terms of cardio-vascular stress, energy expenditure, muscular stress etc. Many studies indicate that women farmers had low score on physical fitness index (**Shalini, 2000, Singh 2000 and Agarwal 2001**). However, there was dearth of information regarding this variable which motive the investigator to study the effect of this variable regarding the workload experienced by women farmers.

Situational variables

Type of activities : Type of activities performed by women farmers seems to play very important role in workload experienced by time. Critical activities are those activities in which heart rate of women farmers goes beyond 106- 110 beats per minute. It was assumed that workload experienced by women farmers was dependent upon type of critical activities. Many studies showed a positive correlation between type of activity and workload in terms of postural stress,

muscular stress, cardio-vascular stress, energy expenditure **(Shalini, 2000 and Singh 2000, Agarwal, 2001)**. Few researches reported that heart rate, energy expenditure varied according to various agricultural activities. Work load was more in digging of land, weeding and hoeing, harvesting and threshing as compared to lavelling, sowing of seeds, collecting weeds etc. **(Sharma and Thakur, 1999; Shalini, 2000)**. Muscular stress was more in cutting and cooking as compared to washing and peeling in food processing industries **(Agarwal, 2001)** Lack of enough literature regarding types of activities and work load has motivated the investigator to include this variable in the present study.

Time spent and distance travelled: Time spent and distance travelled by women farmers in different activities play an important role in workload experienced by women farmers. **Singh (2000)** reported that workload in terms of heart rate, energy expenditure depends upon the amount of load, time spent and distance travelled by them. The health and efficiency of workers depend upon the number of hours they have to work **(Sharma, 1995)**. In case of long working hours the worker is bound to be tired and slacken in his/her duties. Therefore, investigator was keen to investigate the strength of this variable.

3.4 Operational Definitions

Certain terms were operationally defined for measurement of variables of this investigation which are described as follows

Ergonomics: Science analyzing the normal operations of human body for better human input and for maximum efficiency and production.

Ergonomic assessment of workload: It means analysis of normal operations of human body to reduce the ergonomic cost of work and physiological stress.

Workload: The workload refers to the amount of efforts put in by an individual in terms of heart rate, energy expenditure, grip fatigue while performing given task

Critical activities: Critical activities are those activities in which heart rate exceed beyond 106- 110 beats / minute **(Gite,1997, Sharma and Thakur, 1999)**

Women farmer: Woman who possess her land or work on the land of others in crop production, livestock production, horticulture and production work

Organic farming: Organic farming is defined as a system that attempts to provide a balance environment in which the maintenance of soil fertility and the control of pests and diseases are achieved by the enhancement of natural process and cycles, with only moderate inputs of energy and maintaining an optimum level productivity **(Hodges, 1981)**

Organic farming activities: Organic farming activities are those activities in which use of pesticides and chemicals are strictly avoided. Such as collection of cow dung from cattle shed, transportation of cow dung to manure shed, preparation of Organic manure, transportation of manure in the field, weeding, harvesting, winnowing etc.

Sequence of activities: Order in which activities are carried out one after another in the day's schedule

Anthropometric measurement : It is the measurement of human body, including body dimensions and the mechanical aspect of human motions including consideration of range of frequency in an ergonomic model

Heart rate: Beats per minute

Muscular stress: It is decrease in ability to contract and relax the muscles. The absolute limit of power (Grip) in human muscles when decrease it results into muscles stress

Physical fitness: It is the state of health of the selected women farmers. It was assess by using the following formula

$$\text{Physical fitness Index (PFI)} = \frac{\text{Duration of exercise in (Sec)}}{\text{Sum of 1st, 2nd, 3rd recovery pulse count}} \times 100$$

Work rest allowance: It is that time after which the increased heart beats of woman farmer become normal.

Energy expenditure: The normal heart rate and increased heart rate during performance of task are measured and then the energy expenditure is calculated with the help of following formula

Energy expenditure (kJ/min) = [0.159 × Heart rate(beats/min) - 8.72]

(Varghese et. al. 1994)

Classification of workload (Varghese,1994)

Physiological variables

Physiological Workload	Male		Female	
	HR (beats/min)	EE (kJ/min)	HR (beats/min)	EE (kJ/min)
Very light	Up to 75	Up to 7.00	Up to 90	Up to 5.00
Light	75 - 100	7.1 - 10 50	91 -105	5.1 – 7.50
Moderately heavy	101 - 125	10.6 – 14.0	106 - 120	7.6 - 10.00
Heavy	126 - 150	14.10 - 17 50	121 - 135	10 10 - 12.50
Very heavy	151 - 175	17 60 - 21 00	136 - 150	12.60 - 15.00
Extremely heavy	Above 175	Above 210	Above 150	Above 15 00

* HR = Heart rate **EE = Energy expenditure ***kJ = KiloJule

3.5 Selection of the Sample

Locale of the Study : The present study has been carried out in Uttranchal state **(Figure –3. 3)**

Uttranchal is bounded by Tibet (China) in the north and Uttar Pradesh in the south, Nepal in east and Himachal Pradesh in the west

History : Uttranchal is mentioned in the ancient Hind scripture as Kedarkand, Manaskhand and Himavant. It is also called the land of the Gods *(Dev Bhoomi)* because of various holy places and abundant shrines. The hilly region of Uttranchal offers unspoiled landscape to the tourist pilgrim. The present state of Uttranchal was earlier a part of the United province of Agra and Awadh which came into existence in 1902. In 1935, it was renamed as Uttar Pradesh and Uttranchal remained a part of Uttar Pradesh. The demand for a separate hill state of Uttrakhand arose in 1930 for rapid development of Kumaon and Gharwal region. Many committees of the government of U.P. considered it feasible until the agitation by the Uttrakhand kranti dal became violent. That brought out ultimately the new 27th state of India on 9th November 2000 **(Competition Success Review 2002).**

Geographical area covered by Uttranchal is 55,845 sq. km. comprising of 13 districts with a population of 84,79,562 in 2001 Capital of Uttranchal is Deharadun .The percentage of literacy in Uttrachal is 72.78per cent in which percentage of male literacy and female literacy is 84.01 and 60.26 per cent respectively.

Agriculture : About 90 per cent of the population of Uttranchal depends upon agriculture. The net cultivated area in the state is 12,61,915 hectares. The reason for conducting the study in Uttranchal state were :

1. The investigator herself belongs to Uttar Pradesh and earlier Uttranchal was part of it. Hence well versed with social and cultural norms which could facilitate her in establishing good rapport with the respondent for ensuring reliable date.

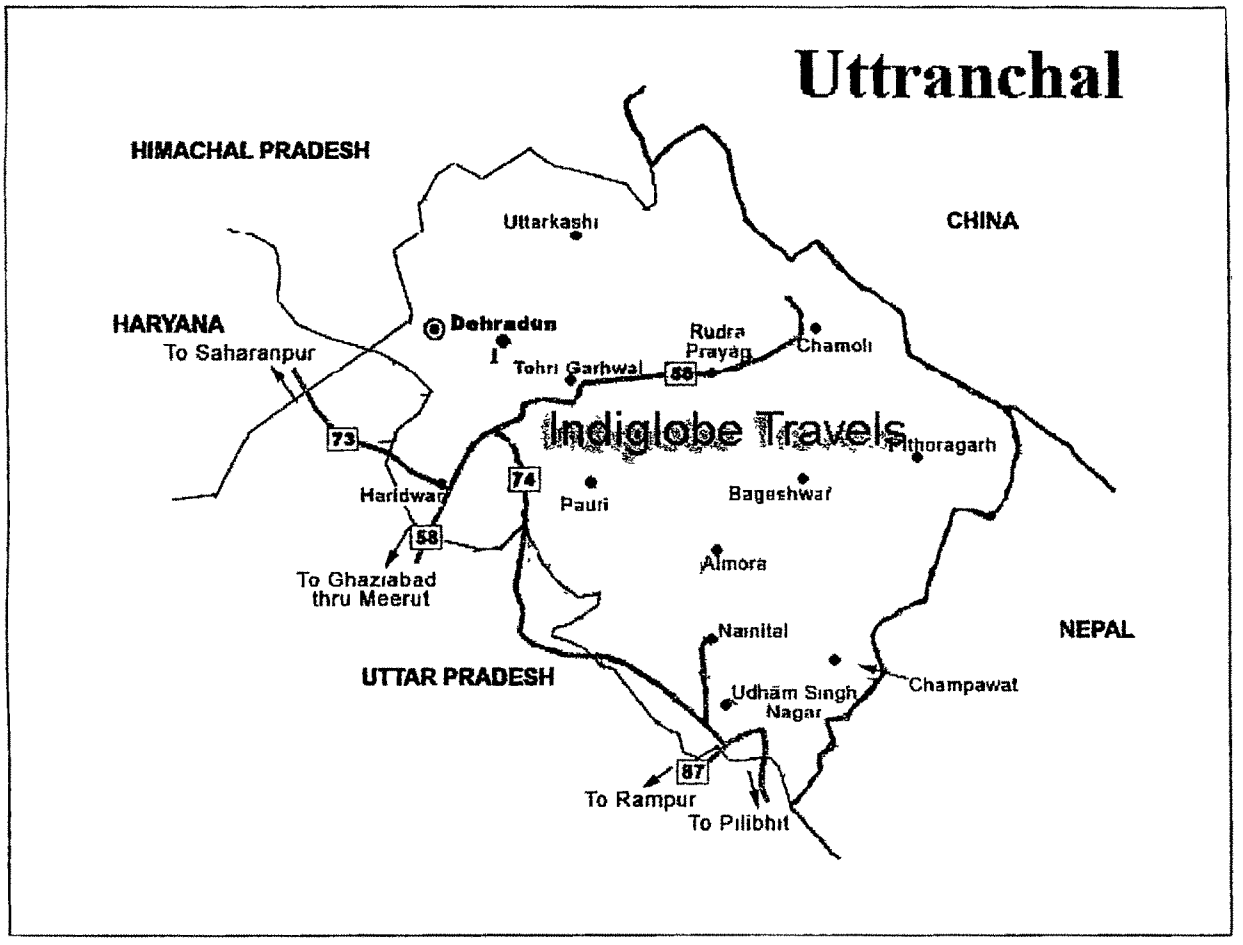


Fig 3.3 Map of Uttranchal.

2. Uttranchal, one of the youngest states of India is geared up to extend its traditionally strong agricultural base into organic framing. Uttranchal had 24 villages as dedicated to organic farming . Uttranchal is now called heaven for organic farming in India . Therefore present study was conducted in Uttranchal state.

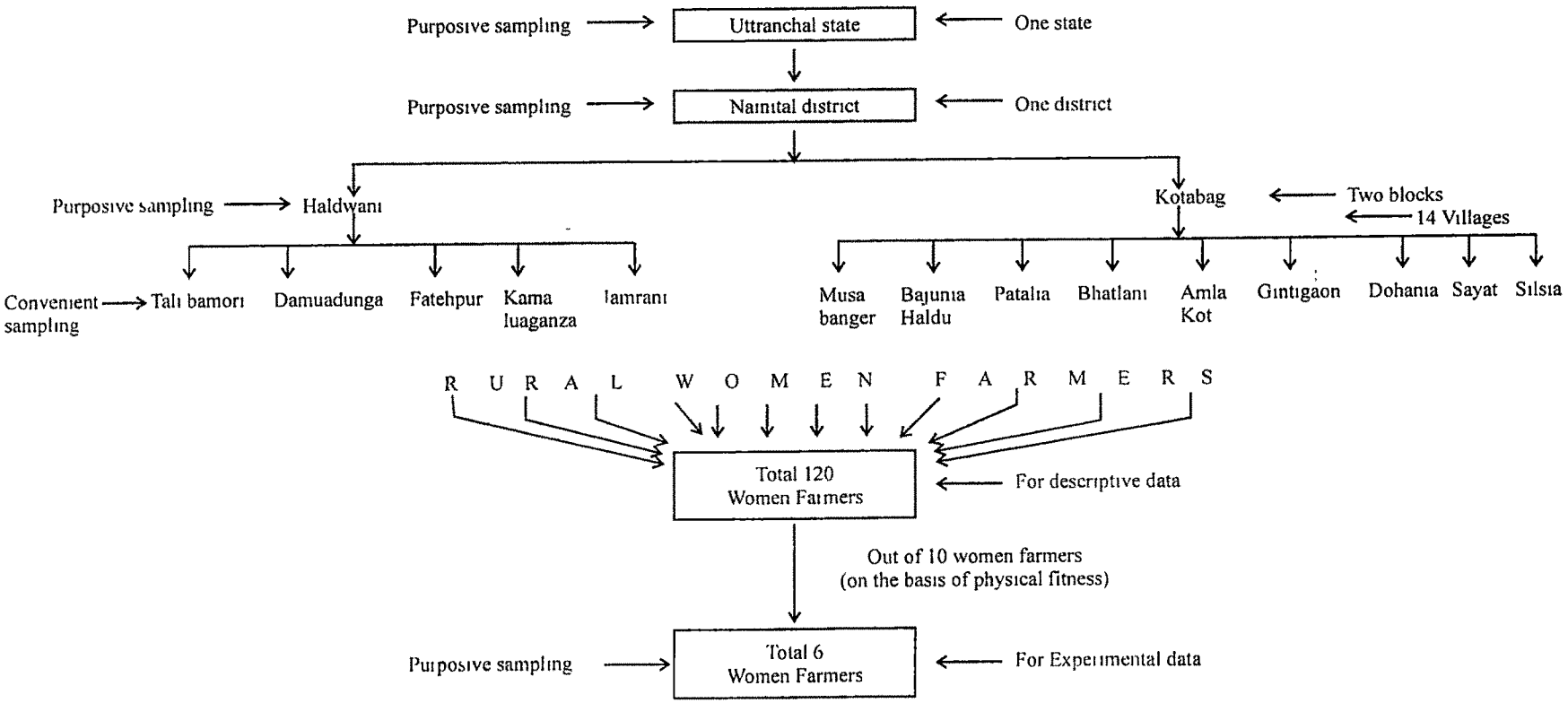
Sampling Design : The multistage purposive cum convenient sampling design was followed to select the study area and respondents **(Fig.3. 4)**. The stages comprised of selection of district, selection of blocks selection of villages and selection of respondents.

Selection of District : Uttranchal state comprises 13 districts. In the first stage Nainital district was purposively selected. The main reason for selection of this district was because most of the population of this district is residing in villages. Mountain farmers have been using forest wastes, animal waste, and agricultural waste for manure in almost all farmlands. Beside this through NGO's a number of interventions for biodegrading and value added technology like bio-dynamic effective microorganisms vermi culture have given rise to improved manuring systems. Geographical area covered by Nainital is 4,767 sq. km. The total population of district was 7,62,912.

Selection of Blocks : For the selection of blocks a list of blocks of Nainital district was obtained from the district development office, Nainital. The Nainital district consist of six blocks, out of which two blocks of Haldwani and Kotabag were purposively selected because all the villages in these two blocks were involved in organic farming. Beside this these two blocks were having *Gramin and Krishi Vikas Samiti* who were promoting farmers about various organic compost methods among farmers

Selection of villages : For selection of villages list of villages under Haldwani block and Kotabag block were obtained. Hence from the list of villages 14 villages were selected The reason for selection of these villages was because they were easily approachable by the investigator.

Fig. 3.4 Schematic Representation of Sampling Design Adopted for the Study



Selection of Households : Total number of households in each selected village was obtain from base line survey data in 2001 as well as from election office of Nainital district. These provided the most up to date record of the households.

From the household lists, it was convenient for the investigator to select the sample of the study. From that list those women farmers who were willingly cooperate in data collection were selected by the investigator. Thus sample size for descriptive data was 120 households and for experimental work ten women farmers were selected, out of them on the basis of physical fitness six women farmers were purposively selected.

3.6 Development of the Instrument

Interview schedule was found to be the appropriate tool which would adequately gather information pertaining to the descriptive part of research work. The schedule comprised of following sections

Section I : Contained the questions to elicit information about the background characteristics of women farmers, years of experience in organic farming etc.

Section II : Dealt with the detailed information regarding source of manure, frequency of application of manure, type of pesticides used, frequency of application of pesticides, pesticides health hazards etc. types of activities performed by women farmers, time spent and type of technology used by women farmers.

Section III : Contained the subjective questions regarding attitude of women farmers regarding organic farming. Beside this it also contained questions regarding body discomfort experienced by women farmers during organic operations.

Experimental data: This part dealt with the experimental data regarding the physical fitness of the women farmers by taking their anthropometric measurements (standing height, weight, blood pressure and physical fitness

test) Beside this it also contained information regarding work load in terms of cardiovascular stress, energy expenditure and muscular stress (grip strength)

Development of attitude scale: For measuring the attitude of women farmers Likert's type summated rating scale was used **Kothari(1985),Best and Khan(1989)** It was observed through literature survey that this method gives consistent results comparable to other methods.

Item collection : Statements pertaining to the variables were gathered. The following criteria was borne in mind while editing the statements regarding attitude of women farmers regarding organic farming.

1. The statements should be brief, simple, clear and direct.
2. The statements should be such that it can not be interpreted in more than one way.
3. Each statements should contain only one complete thought.
4. The statements should be expressions of desired behavior rather than expression of facts.
5. No statement should have double negative or conforming expressions.
6. Double barelled statements should be avoided.
7. Statement should be in the from of simple sentences rather than in the form of complex sentences.

Thus statements were thoroughly screened in order to make them more simple, clear and meaningful for eliciting maximum information.

Content validity of attitude scale : For establishing the content validity of attitude scale a list of 31 statements were given to a panel of 15 judges, consisting of experts from department of Home management, Faculty of Home Science and Department of Extension from College of Home science and Department of Economics, Department of Agronomy, Collage of Agriculture at G. B. Pant University of Agriculture and Technology Pantnagar. The judges

were specially requested to indicate the direction of the attitude as expressed by each statement. e.g. Statement that favoured the attitude towards organic farming and vice-versa.

In addition they were also requested to indicate the clarity, relevance, irrelevance ambiguity of statement. The judges responses were coded and tabulated. The following criteria served as a basis for the selection of statements.

1. Any statement reported as clear by eighty percent or more 4judges was to be included in the scale.
2. Those statements where eighty percent or more of the judges agreed on the direction of the attitude were included in the scale.
3. Any statement reported as ambiguous by three or more judges to be modified and checked by at least five judges to be included in attitude scale. All the criteria were considered simultaneously. 23 statements were chosen for inclusion in the attitude scale to be used for pilot studies.

Pre-testing / pilot study of the schedule :The instrument prepared was pretested on 30 randomly selected rural women of a non-sampled village. Pretesting / pilot study was done to check the clarity of the interview schedule and to established the reliability of scale. Few changes were incorporated in the interview schedule e for final data collection.

Reliability of the instrument :Reliability refers to the accuracy (consistency and stability) of measurement by a test **(Anastasi, 1982).** The reliability varies from zero to one, having the former value when the measurement involve nothing but error and reaching the later value only where there is no variable error at all in the measurement. So to ascertain the reliability of the instrument the following procedure was adopted.

Item analysis for attitude scale : The 23 items of attitude scale were administered to 30 respondents selected for the pilot study. The response of

each of the statement of the scale was quantified by ascribing scores. A three-point scale was applied and scores of 3, 2, 1 were assigned to the responses. 'Agree', 'Undecided', and 'disagree' respectively for statements depicting a positive attitude and the scoring was reversed for those depicting a negative attitude. The purpose of using a three-point scale was to enable the rural women as they might not be able to differentiate the intensity of their feelings in a more definite manner in five point scale. The total score obtained by all 30 respondents were arranged in descending order. The top 33 percent (10 respondents) and the bottom 33 percent (10 respondents) were selected for item analysis as high and low groups respectively. The middle group was omitted from the analysis. Item analysis was carried out by using mean difference with modification **(Edwards, 1957)** and items with mean difference mean H - mean L more than grand mean difference :

$\frac{\sum MH}{n} - \frac{\sum ML}{n}$ were selected.

Where, MH = Mean of high scorer groups for each statement.

$\sum MH$ = Sum of mean of high group of all statements

ML = Mean of low scorer group for each statements.

$\sum ML$ = Sum of mean of law group of all statements.

N = number of statements.

The mean and grand mean difference were worked out between high and low group of 23 items for items selection **(Appendix - I)**

Selection of items : The next phase was to determine the relevance of a particular item in order to reduce the number of items from a small but efficient scale and to maintain the internal consistency of the scale. Item analysis data were used for final selection of the item. Out of 23 statements, 10 statements were dropped and the remaining 13 statements with mean different

more than grand mean difference i .e. 1.10 were considered valid and were included in the scale.

Validity of the scale : The item analysis of difference between the means of high and low groups and the selecting items with mean difference more than grand mean difference for each item were the magnitudes which justify discrimination power and hence were indicating the scales as valid measures of attitude of rural women. Thus the validity was built on the process of preparation of the scale.

Reliability coefficient of the attitude scale : A test score is called reliable when it has reasons for believing the score to be stable and trustworthy. Stability and trustworthiness depend upon the degree to which the score is an index of 'true ability' i.e. free of chance error. Spilt half method was used for measuring the reliability of present study.

Split half method : In the split half method, the test is first divided into two equivalent 'halves' and the correlation found for these half tests.

$$R = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \cdot \Sigma y^2}}$$

The procedure in detail, is to make up two sets of scores by combing alternate items in the test. The first set of scores for example, represent performance on the odd numbered items 1,3,5,7, etc. and the second set of scores, performance on the even numbered items 2,4,6,8, etc. The reliability coefficient of the whole test may be estimated from the Spear man brown prophecy formula.

$$r\,II = \frac{2r\,\tfrac{1}{2}\ I/II}{1 + r\ \tfrac{1}{2}\ I/II}$$

Where r II = reliability coefficient of whole test

r ½ I/II = reliability coefficient of half test.

Reliability of the scale was found to be 0.74.

3.7 Method of Data Collection

Interview schedule was used for collection of descriptive data and for experimental data following procedure was followed

Experimental data

Suitability of the subjects: In order to avoid the errors in the experimental data, suitability of the subject was ascertained by measuring the following physiological parameters viz.

1. Body temperature (Not above 99°F or 37°C)
2. Blood pressure (120/80 ± 10 mmHg)
3. Heart rate (70 - 90 beats / minute)
4. Physical fitness test (81 - 150)
5. Aerobic capacity of the subjects (15 –45 ml/kg min.)
6. Height, weight and age (more or less same)

Beside this women farmers did not have any disease / health problem She should not be a pregnant lady. Out of ten women farmers six were selected for final experiment, their cardio-vascular stress, muscular stress (grip strength), energy expenditure was recorded. For measuring the workload of these six women farmers number of live stock and distance traveled by them kept constant

Different Parameters taken for the measurement of workload and physical fitness of women farmers **(Fig3. 5a &3 5b)**

Physical Fitness Index (PFI) · Physical fitness index of women farmers was measured with the help of wooden stool ergometer Specification of wooden stool is given in **appendix (III)**

Procedure: First of all women farmers were given enough of rest and then her resting heart rate was measured with the help of heart rate monitor (Polar heart rate) After the complete rest, the women was asked to do the stepping activity

on the wooden stool ergometer. During the stepping activity heart rate of the respondent was recorded for the entire stepping period with an interval of one minute each. after 5 minutes of stepping activity, the women was asked to sit on the resting chair and her recovery pulse rate for 5 minute at an interval of one minute each was again recorded in the same way then the physical fitness score was calculated by using following formula.

$$\text{Physical fitness index (PFI)} = \frac{\text{Duration of stepping (sec)}}{\text{Sum of I,II,III min recovery pulse count}} \times 100$$

Interpretation of score

PFI score	Level of Physical fitness
Up to 80	Poor physical fitness
81 - 100	Low average
101 - 115	High average
116 - 135	Good
136 - 150	Very good
Beyond 150	Excellent

Description and procedure for using instruments / formulas

For physical fitness:

Measuring tape: It is available in variety of materials namely metal, plastic etc. The length of the tape also varies. For measuring the standing height of women farmers, plastic measuring tape was used. Height was recorded in centimeters.

Weighing balance: Weighing balance was used for taking the weight of women farmers. Weighing balance was set on zero point. Women farmer was

asked to stand straight on the platform without shoes and any support Their weight was recorded in kilograms.

Aerobic capacity: Aerobic capacity or Vo2 maximum refers to the maximum oxygen uptake capacity and is consider as the best measure of one's physical work capacity or physical fitness. Vo2 maximum or aerobic capacity was calculated from individual's age and body weight by using the proposed formula by **Varghese, et al (1994)**

Vo_2 maximum = 0.023 × body wt. (kg) - 0.034 × Age (years) + 1.652 (l/min)

Interpretation of score

Vo_2 maximum (aerobic capacity) ml/kg min	**Level of interpretation**
Up to 15.00	Poor
16 00 - 25.00	Low average
26.00 - 30 00	high average
31 00 - 40.00	Good
41.00 - 45 00	Very good
Beyond 45.00	Excellent

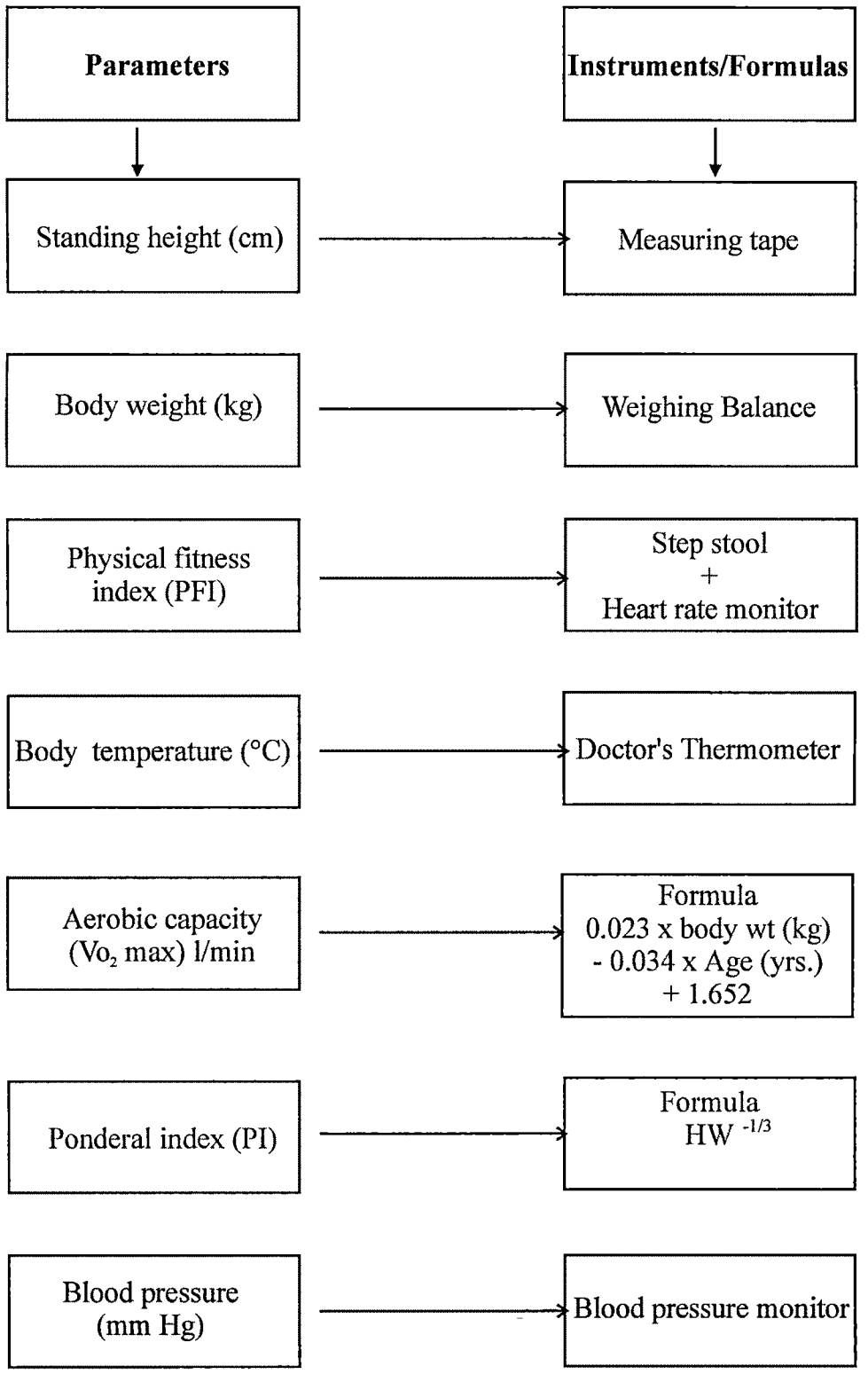
Body temperature: Body temperature of women farmer was recorded by thermometer Thermometer was put under the tongue of respondent for three minutes after that thermometer was took off and her temperature was recorded Temperature of women should not exceed beyond 99° F

Ponderal index The following formula was used (Roozbazar et al 1979)

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

PI= Ponderal Index, H = Body Height(cm)
W = Body weight (kg)

Fig 3.5a Equipments Used for Measuring Physical Fitness of Women Farmers



Interpretation of score :

Score	Body type
< 20	Ecto morphic
20 –25	Meso morphic
> 25	Endo morphic

Critical activities: According to **Sharma and Thakur (1990)** the activities like digging of land, weeding and hoeing, harvesting, fetching of fuel, fetching of fodder, threshing and winnowing, leveling and transplanting were critical activities as the heart rate recorded in these activities reaches beyond 110 beats / minute. The similar recording was acquired by **Shah et al (1970)** who also reiterated that heart rate beyond 110 beats/min produced under physiological stress/strain and therefore required rest pause.

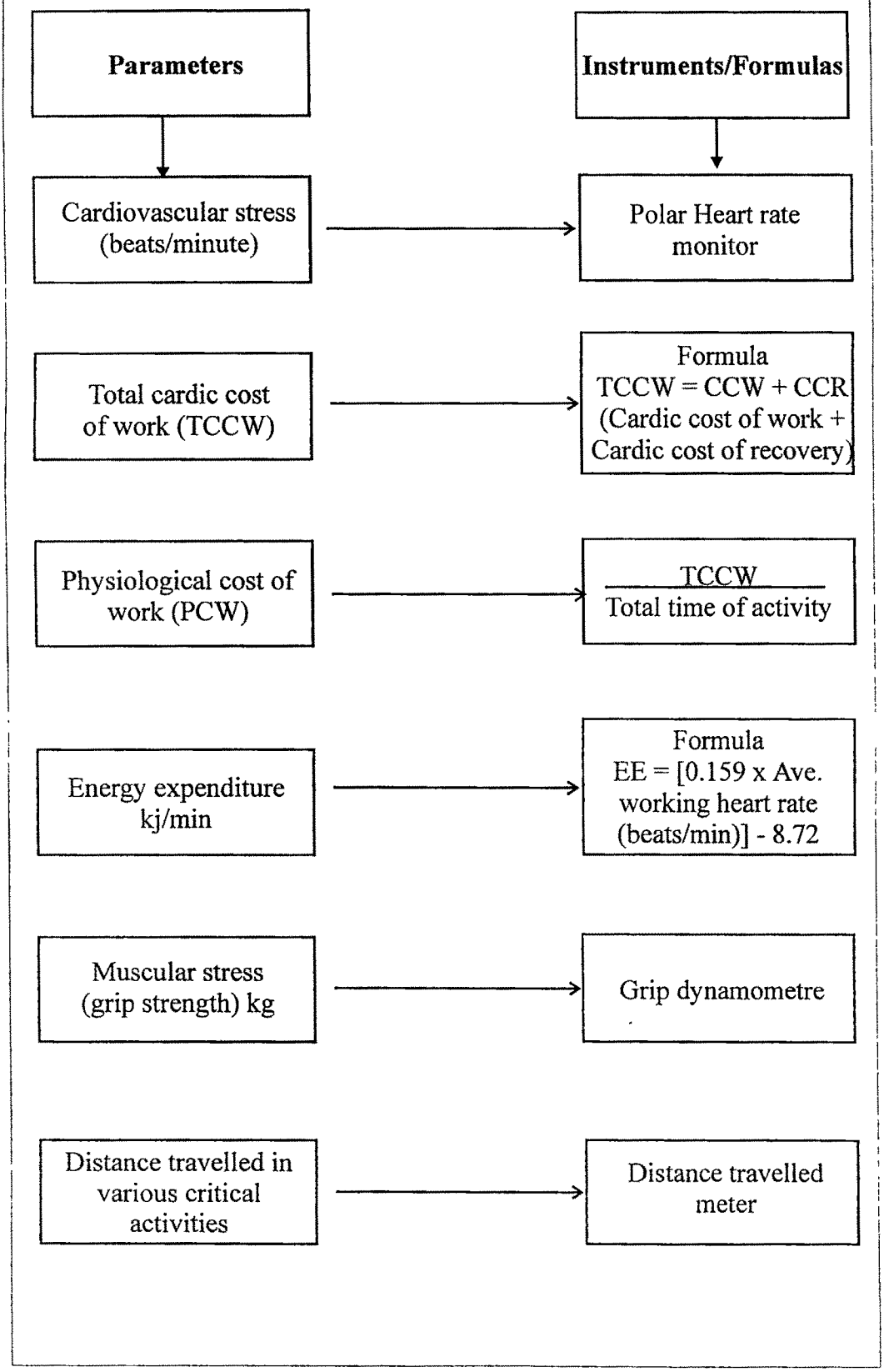
Shah et al (1979) reported that generally a workload which requires oxygen at a rate about 35% of vo2 maximum is considered as acceptable workload for Indian workers and the values workout to be 0.70 liter/min. and 0.63 liter/min. for male and female workers respectively (**Gite, 1993**). The corresponding heart rate values for this workload will be about 110beats/min.for male and 105beats/min for female. Following activities were standardized as critical activities

Collection of cow dung : For preparation of organic manure, collection of cow dung was done daily by all women farmers. It involves 15 minute to half an hour.

Transportation of cow dung to manure shed : After collecting the cow dung women farmers carry the cow dung to manure shed. It takes usually 10 -15 minutes daily depending upon the distance of manure shed from animal shed.

Preparation of manure : It is done weekly when huge amount of cow dung was collected it requires 3 - 4 hrs for preparation

Fig.3.5b Equipments Used for Measuring Work load of Women Farmers



wear the polar heart rate monitor on her wrist and allowed working in the field. Reading of heart rate was displayed on heart rate monitor. The investigator should wear time watch during recording of readings.

Procedure : For measuring the cardio - vascular stress test code of Central Institute of Agricultural Engineering (CIAE) Bhopal was followed. According to that procedure recording of heart rate was as follow:

1. Select the six subjects who were well accustomed to all operations (collection of cow dung, weeding, harvesting etc.)
2. Examine the subject for normal health (by physical fitness test)
3. Train the subject in operation.
4. Note the age, weight, height of the subjects and compute the mean and standard error.
5. The minimum length of test plot shall be twenty meter.
6. The experiment was conducted using randomized block design where subject were considered as sub treatment and critical activities performed by them were main treatment. (**Appendix IV**)
7. The trials should be planned statistically.
8. Each trial should be of 15 minutes duration and three such trials should be carried out for each subject for each activity.
9. All the subjects should be informed about the purpose of the study to enlist her full cooperation.
10. First of all, give warming up exercise to the subject for 15 minutes at a speed of 3km/hour. After that allow the subject to take rest for a period of 30 minutes.
11. Heart rate monitor should be used to measure the heart rate of the subject during trails. Fix the heart rate monitor to the subject during the rest period

12. Allow the subject to calm for five minutes in sitting posture in the shed and measure the data for rest condition. Don't allow the subject to talk and eat during resting period.

13. Now ask the subject to perform the activity at the appropriate speed.

14. Note/record the data for heart rate of 6th to 15th minute of operation. If any reading is very different from other ones than delete that reading and find out the average heart rate from remaining readings.

15. After 15 minute of operation the subject shall be given a rest of 15 minutes during that recovery pulse rate was counted.

16. Repeat the procedure to get three sets of readings of all the selected subject.

Total cardiac cost of work: It is a sum of cardiac cost of work and cardic cost of recovery. It can be measured by applying following formula.

TCCW = CCW + CCR

Where TCCW = Total cardiac cost of work

CCW = Cardiac cost work

CCR = Cardiac cost of recovery

Further,

CCW = Average Heart Rate (AHR) × Duration

AHR = Average Working Heart Rate (AWHR) - Average Resting Heart Rate × Duration

CCR = Average Recovery Heart Rate - Average Resting Heart Rate × duration

Physiological cost of work (PCW) It is calculated by dividing total cardiac cost of work with total time of activity.

$$\text{PCW (beats/min)} = \frac{\text{TCCW}}{\text{Total time of activity}}$$

Energy expenditure : Energy is the power of doing the work. It varies from one activity to another depending upon the nature of activity. Energy expenditure rate of a worker performing a job is calculated from cardio - vascular stress data. The following formula is used for calculating energy expenditure.

Energy expenditure (KJ/min) = 0.159 × Average heart rate (beats/min) - 8.72

Grip dynamometer : As the name itself indicate stress on the grip of muscles of the hand was recorded with the help of grip dynamometer. It consist of a handle for hand grip connected with a spring to a pointer on the marked dial. The strength of grip muscles was calculated in kilograms (kg).

Procedure : The subject whose grip fatigue is to be measured is asked to pull the grip handle before the start of the activity separately with the right and left hand and reading on the dial was noted down in kilograms. Again immediately after the completion of activity the subject was asked to pull the handle again and the reading on the dial of grip dynamometer was recorded.

Grip fatigue was calculated by applying following formula :

$$\textbf{Grip strength in \%} = \frac{\textbf{Sr - SW}}{\textbf{Sr}} \times \textbf{100}$$

Where Sr = Strength of muscles at rest

Sw = Strength of muscles after work

Distance travelled meter : It was used for measuring the distance travelled by women farmers in different critical activities. Distance was measured in meters. For all activities distance traveled by six women farmers kept constant.

3.8 Analysis of Data

Categorization of the variables for the purpose of analysis and tabulation.

For the purpose of analysis, variables of the study were categorized as given below.

Age : Age was measured in terms of number of full years the respondent completed at the time of interview. It was categorized as:

Young : 16 -35 years

Middle : 36 -49 years

Old : above 50 years

Education level : It refers to the formal education attained by the respondent. It was categorized as :

Variable	Coding
Illiterate	1
Can read and write only	2
Primary	3
Middle	4
Metric	5
Intermediate	6
Graduate	7
Post graduate	8

Size of family : Family size refers to the total number of members in the family consisting of husband, wife, children and other dependents residing under same roof and sharing It does not include the children who left the house after marriage or expired the same kitchen. The family size was categorized as:

Small : less than 5 members

Medium : 5 to 10 members

Large : greater than 10

Size of land holding : Land holding refers to the standard areas, size of cultivated land possessed by an individual family. Range for size of land holding was decided according to **Rural Area Research Hill Development Corporation (1980)**Size of land holding was categorized as

Variable	Range (Acres)
Marginal or no land	≤ 1.0
Small framers	1.0 - 2.0
Medium framers	2.1 - 4.0
Large farmers	≥ 4.0

Occupation of farmers : It was categorized as coding

Variable	Coding
Self farming	2
Tenant framing	1

Monthly income of family : Family income refers to the monthly income derived from various sources of respondents family such as farm produce, service livestock, business and other sources. Family income ranged were decided according to **Taxation Enqiry Committee(2001)**

Category	Range of income
Low income level	Upto Rs. 1700
Medium income level	Rs. 1,701 to 4200
High income level	Rs. 4201 to 8400

Livestock possession : It refers to number of livestock possessed by farmer.

Category	Range
Small	< 6
Medium	6 – 10
Large	> 10

Attitude : The respondents near categorized as having favourable, neutral or unfavorable attitude.

It was categorized as :

Category	Score range
Unfavorable	13-21
Neutral	22-29
Favorable	30-39

Body discomfort : Discomfort is the body pain accusing as a result of the excessive stress on muscles due to the effort involved in the activity. Sometime it is also called as overall discomfort or simply discomfort. For measuring the body discomfort intensity body map was used. (Fig. 4.1) For measuring the body discomfort intensity single noun verbal rating scale was adopted. (**Straker, 1997**). It was Categorized as :

Body discomfort	Score range
Severe	1
Moderate	2
Low	3

Statistical Analysis of Data : The data collected were coded according to code number assigned and were analyzed employing descriptive as well as relational statistics.

Descriptive statistics : The data were presented in frequencies, percentages, mean and standard error for analysing the following information.

1. Personal, family and situational variables namely age, education, occupation and size of land holding etc.
2. Agriculture related data.Data related to types of technologies, time spent and distance travelled.
3. Data related to attitude and body discomfort experienced by women farmer.

Ralational statistics : One way ANOVA test, simple t- test, Karl Pearson product moment correlation was complied to find out the relationship between variables

The formulas used for different variables were as follows.

Frequency : The sum of responses (in numbers).

Percentage : For making sample comparison the percentage value were calculated.

$$P = \frac{n}{N} \times 100$$

Where n = Frequency of particular cell

N = Total number of women farmers of that particular cell

P = Percentage

$$\text{Mean} = \frac{\text{Total sum of the responses}}{\text{Total number of responses}}$$

Mean score : Mean score was calculated by dividing the sum of observations by the number of observation

$$\bar{X} = \frac{\Sigma XI}{n}$$

Where $\bar{X}$ = mean score

ΣXi = sum of all observations

i = 1,2,3..... N

N = Number of observation in a group

For the statements of attitude scale and body discomfort scale scoring was done on the basis of three points i.e.

Attitude scale	Body discomfort
Agree = 3	No = 3
Undecided = 2	Moderate = 2
Disagree = 1	Severe = 1

Standard deviation : It is degree of deviation in terms of mean value.

$$\text{S.D.} = \pm\sqrt{\frac{1}{n-1}\left(\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right)}$$

Standard error (S.E)

$$\text{S.E.} = \sqrt{\frac{\text{S.D}}{n-1}}$$

$$\text{Coefficient of variance (cv) \%} = \frac{100\sigma}{M}$$

Where σ = S.D

M = Mean

Relational statistic : Statistical analysis was carried out to test the relationship between selected variables and the hypotheses postulated for the study.

Analysis of variance was computed to study the critical differences among various activities regarding cardio-vascular stress (heart rate), energy expenditure, total cardic cost of work, physiological cost of work, grip strength and work rest allowance.

Karl pearson product moment coefficient of correlation. It is the ratio which expresses the extent to which changes in one variable are accompanied by or are dependent upon changes in a second variable.

The following formula was used for measuring coefficient of correlation between two variables.

$$r = \frac{\sum xy}{\sqrt{\sum X^2 \times \sum Y^2}}$$

Coefficient of correlation when deviation are taken from the means of the two distributions significance of correlation was tested by using t - test

$$t\ cal = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

Simple t-test was used for analysing the difference between before and during the work in different critical activities.

$$t = \frac{\overline{X_1} - \overline{X_2}}{\frac{(N_1-1)S_1^2 + (N_2-1)S_2^2}{N_1+N_2-2}\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}$$

One way analysis of variance (ANOVA) test

This test was used for determining the significance of difference between means.

Test statistics for ANOVA one way classification

H_O : $\mu_1 = \mu_2 = \mu_3$ . .. .

H_1 . all means are not equal

The value of F cal was compared with tabulated value of F at $(n_1 - 1)(n_2 - 1)$ degree of freedom at 0.01 and 0.05 per cent level of significance.

Factor A due to assignable factor	K –1	$S^2A = \sum_{i=1}^{K} \frac{Ti^2}{ni} - C.F$	$S^2A = \frac{S^2A}{K-1}$	$\frac{S^2A}{S^2E}$
Error due to chance	N – K	S^2E	$S^2C = \frac{S^3E}{N-K}$	--------
Total	N(K-1)	TSS	-----	--------

Where

K = Total number of classes

G = Grand total = Sum of all observations

C.F = Correction factor = G^2/N (Grand total square / Total number of observation)

S^2A = Sum of square due to factor A

$$= \left(\frac{T_1^2}{n_1} + \frac{T_2^2}{n_2} + \cdots\cdots \frac{Tk^2}{nk} - C.F \right)$$

$$= \sum_{I=1}^{K} \frac{T_1^2}{ni} - C.F$$

TSS = Total sum of square = sum square of all observation - C.F

$$S^2e = \frac{S^2E}{n-K}$$

$$S^2a = \frac{S^2A}{K-1}$$

$$SE^2 = TSS - S^2A$$

If calculated value of F is more than the tabulates value of F, than we reject Ho at 0.01 and 0 05 per cent level of significance F cal $\geq$ F tab[(k-I) (n-k)]