
Methodology

CHAPTER III

METHODOLOGY

The concern of this chapter is to present the methodology / strategy designed in order to find answer to the research questions posed for the study. In order to reach the aims of the present study, a detailed plan of work and sequential procedure are required. The research design, conceptual frame work, showing the relationship of variables, description of the variables and operational definitions of the term used in the study are explained briefly. The sampling techniques, section and construction briefly. The sampling techniques, section and construction of tool for data collection, the method of data collection and analysis of data are also described for the study. The methods are discussed under following heads.

(i) Research Design.
(ii) Conceptual frame work of the study.
(iii) Variables
(iv) Operational Definitions
(v) Development of the instrument
(vi) Selection of the sample
(vii) Method of data collection
(viii) Analysis of data.

3.1 Research Design

A descriptive cum experimental research design was used for ergonomic assessment and modification of technologies used by women in Organic farming.

A descriptive survey to collect data was thought to be most appropriate (Best and Khan, 1980). A post facto research design was adopted, to test relationship between variables. Descriptive design focused on collecting information on selected descriptive aspects of study and test relationship between in various components.

The experiment design focused on physiological cost of work and body discomfort. The research design incorporated a causal comparative component to have a clear cut study of impact of the traditional and improved technologies. This lead to the assessment and modification of technologies from the point of view reduced physiological cost of work and physical discomfort experienced while working with traditional and modified technology.

Test Area	→	Physiological cost of work with modified technologies or technological advancement. (y)
Control Area	→	Physiological cost of work with traditional technology (z)
Effect of technological advancement	→	(y) – (z)

Figure 3.1 Causal Comparative Component of the Research Design

3.2 Conceptual Frame Work of the Study

Conceptual frame work of the study was discussed in following two sub headings

- Conceptual frame work for descriptive study.
- Conceptual frame work for experimental work.

Conceptual Frame Work of the Descriptive Study

It was conceptualized that discomfort experienced by woman farmers among various activities was affected by their personal, family and situational variables.

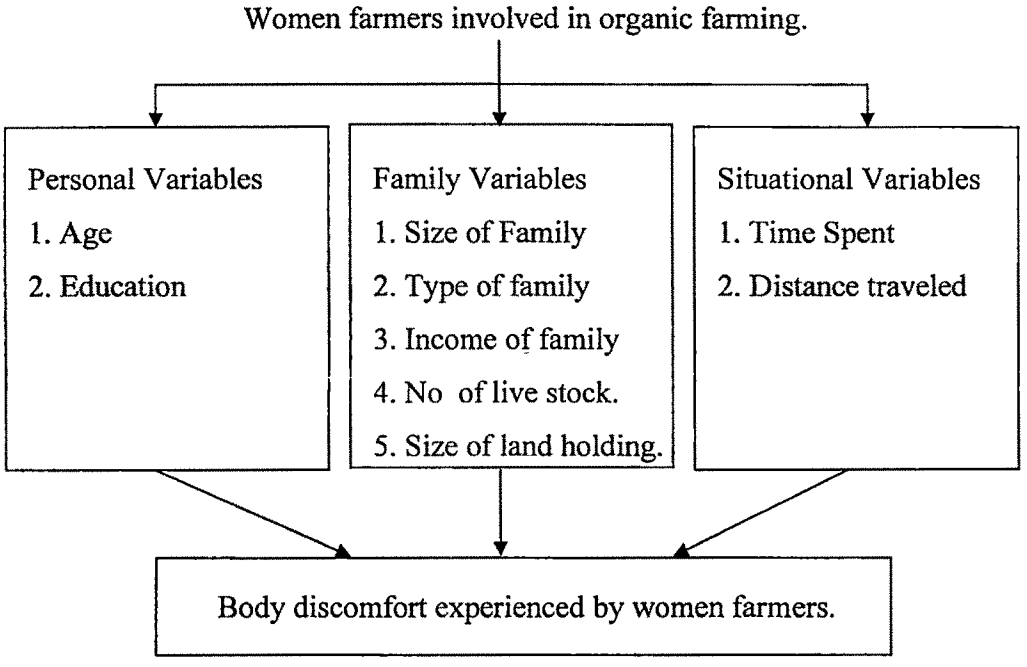


Fig 3.2 (a) Conceptual Framework of Descriptive Study.

Conceptual Frame Work of Experimental Study

It was conceptualized that women's physiological cost of work performance was affected by work related and worker related variables. The work related variables included types of activities, times spent and distance traveled variables and worker related variables such as physical fitness index, age and ponderal index of women farmers also affect the physiological cost of worker and body discomfort. The physiological cost of work was to be seen in terms of heart rate, energy expenditure, total cardiac cost of work, postural stress, muscular stress (Grip Strength). It was further conceptualized that with

the use of modified of technologies, would reduce the physiological cost of work and body discomfort experienced by women's farmers involved in organic farming. It was also expected that attitude of women farmers towards acceptance of modified technologies.

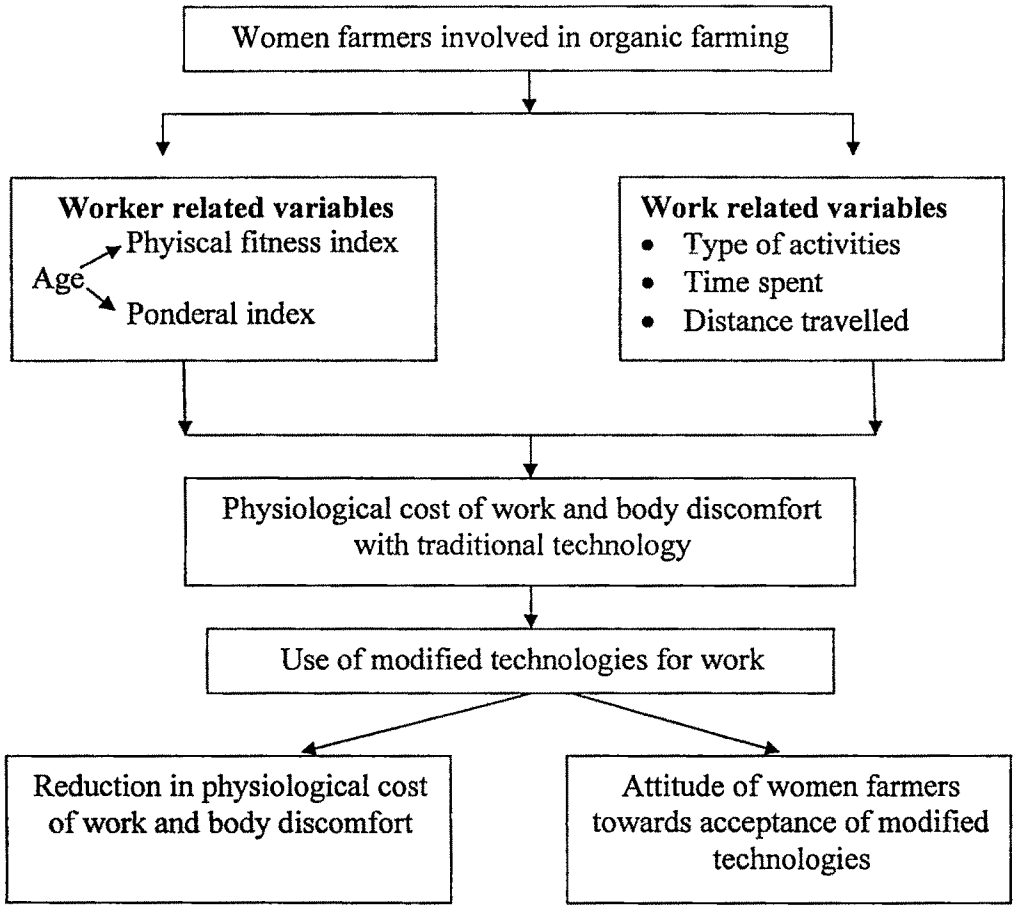


Fig. 3.2 (b) Conceptual Frame Work of Experimental Study.

3.3 Variables of the Study

A variable is any characteristics 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 for both descriptive as well as experimental work.

Hypothetical Relationship of Variables for Descriptive Work.

It was assumed that personal variables i.e. age and education level of respondent, family variables, i.e. size of family, type of family, size of land holding and number of live stock and situational variables i.e. time spent and distance travelled affect the attitude of women farmers towards acceptance of modified technologies used in organic farming. Besides this body discomfort may be affected by their personal, family and situational variables (fig. 3.3. (a))

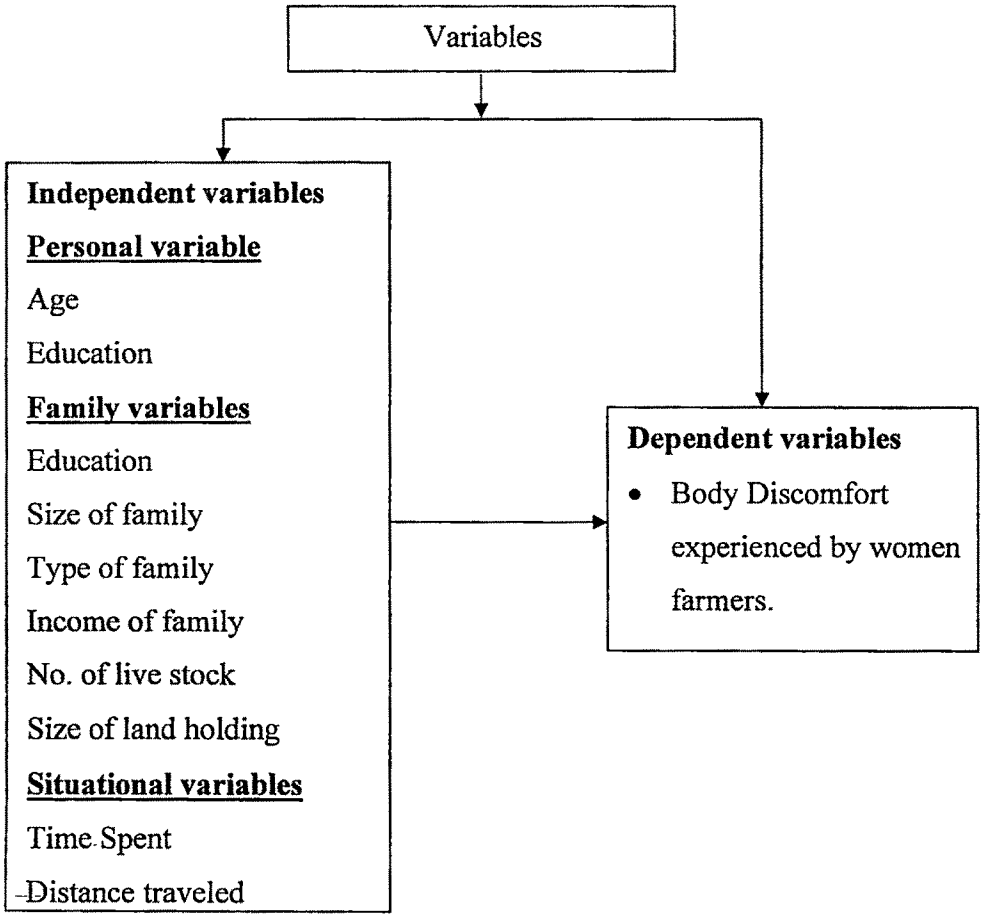


Fig 3.3(a) Hypothetical Relationship of Variables for Descriptive Work.

Dependent Variables

Body Discomfort

Body discomfort is the pain experienced by women farmers. It is a 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 Jafferey, 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 it was found that headache, backache, lumber pain, wrist pain, fore arm pain, limb pain were experienced by women farmers. Studies conducted by Shalini (2000) indicated that body discomfort were very common among women involved in farming. Sharma (1995) reported that occupational health problems list strain on shoulders due to strenuous working posture, pain in hips, neck and back discomfort due to repetitive 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 is 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

It included personal, situational and familial variables. For the current study focusing on women and technologies used in organic farming following personal, familial and situational variables were studied.

Personal Variables

- Age of women farmers.
- Education level of women farmers.

Family Variables

- Type of family.
- Size of family.
- Income of the family.
- Size of land holding.
- Number of live stock in the family.

Situational Variables

- Time spent on activities
- Distance traveled in various activities.

Personal Variables

Age: Age is an important personal factor and in rural social system in India. It commands respect and authority in India. This was more important in case of women, whose status was determined by the number of years she had spent in her in – laws home. Kaur (1986) stated that work participation of women decreased with increase in age. Age was also considered an important variable affecting the body discomfort / health problems experienced by women involved in various occupations. The studies showed that body discomfort among older women as compared to younger one involved in construction work, and agricultural labour (Shalini 2000). Age of the women farmers was considered to be an important variable influencing task performance (Sandhu, 1976; Singhal, 1989). The studies showed that with the increase in age, time spent on household and agricultural activities decreased and vice versa. On the basis of the size of land holding it was also found that body discomfort experienced by marginal women farmers was more as compared to large

farmers. Moreover, it was assumed that age also affects the acceptance of modified technologies used in organic farming. However, literature reviewed showed dearth of information regarding this relationship. Hence, it was considered essential to investigate its relation with acceptance of modified technology as well as body discomfort in various activities of organic farming for the present investigation.

Education level of the women farmers: Education was one of the important variables which indicate the condition of women in any society and attitudes of society towards its women. Education as a variable has been investigated by many research workers for its influence on various improved practices. Literacy level also reflects the cognitive component of the women and can affect qualitatively the time spent on various infrastructural facilities and access to technologies that may again determine her status. In Uttranchal a majority women farmers were involved in organic farming therefore it was necessary to find out the impact of education level on acceptance of modified technologies by the women farmers in 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, 1972 and Borah 1991). Hence it was thought to be appropriate to include educational level as an independent variable for the present study.

Family Variables

Size of Family: Size of family was considered important variable affecting the attitude of women farmers towards acceptance of modified technologies in organic farming and body discomfort experienced by women farmers. Lack of literature exploring the influence of size of family regarding attitude of women

farmers towards acceptance of modified technologies and body discomfort experienced by women farmer, inspired the investigator to incorporate this variable in the present study. However, family size was found to be associated with time use patterns of women in various farm, live stock 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. Almost all the studies have unanimously established a positive association of family size with time use pattern i.e. an increase in time used on house hold work with an increase in family size. But none of the studies which the investigator came across had explored the linkage of family size with use of technology and its effect on time spent in organic farming. Thus, family size was taken as an independent variable for the study.

Type of family: Various researchers have reported a significant relationship between type of family and women's participation in decision making. Sharma and Singh 1984, Puri 1971; and Awasthy 1982 reported that in nuclear families the involvement of women in all family decision was more, especially in the field of agriculture. Hence, type of family was taken as an independent variable for the current study.

Size of land holding: Rural women have been time honoured partners with men. Verma and Malik, 1984; Jain, 1986 and Agarwal 1983 observed marked variations in the study in which women participated and their access to technology according to the size of land holding. The size of land holding plays a significant role in time spent by women in live stock and farm activities (Munjal et al 1984 and Agarwal 1985). Time spent in various tasks 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 towards acceptance

of modified technologies in organic farming and size of land holding. Hence the investigator was interested in finding out its relationship with acceptance of modified technologies for organic farming.

Number of livestock: Recognizing livestock as a major component of rural women's work in Uttranchal, it was assumed that it might be having an effective association with consumption and expenditure pattern of the rural households. It was assumed that number of livestock might be having an effective association with attitude of women farmers towards acceptance of modified technologies in organic farming. Because more the number of livestock, more would be the time spent in live stock activities which might lead to body discomfort experienced by women farmers. Rural women are mainly responsible for livestock work. Farm technologies may also have differential effect on time spent by women farmers in livestock activities. Jain, 1980; Day, 1981 and Singhal, 1989 reported that number of livestock affects the time use pattern of women farmers. It was also proposed that increased number of livestock, lead to increased organic animal waste. 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 researchers. Significant association was found to be established between time use pattern and family income (Bafna, 1979; Sandhu, 1985; Jain 1989; Singal 1989).Many researchers have established a significant association of family income with status of women and level of living of the family. Farouq (1980) indicated that hours of productive work increased when a person's family capital becomes smaller, thus enhancing their income participation. Jain (1986) pointed that an association existed between women's participation in agricultural work and family's income. The investigator was keen to find out the strength of this variable on the attitude of women farmers and the body discomfort experienced by respondents.

Situational Variables

Time spent and Distance traveled: Time spent and distance traveled by women farmers in different activities play an important role in attitude of women farmers towards acceptance of modified technologies in organic farming and body discomfort experienced by women farmers. This was an important parameter. Moreover, there was dearth of information regarding attitude of women farmers towards acceptance of modified technologies in organic farming and time spent and distance traveled. Hence the investigator was interested in finding out its relationship of these parameters.

Hypothetical Relationship of Variables for Experimental Work: For the present study age and type of activities were independent variables which would affect body discomfort, physical fitness index, ponderal index, physiological cost of work with traditional technology in terms of heart rate, energy expenditure, total cardiac cost of work, muscular stress experienced by them. Besides this time spent and distance traveled also affect the dependent variable physiological cost of work and body discomfort. It was assumed that there will be reduction in physiological cost after introducing the modified technologies. A detailed discussion of variables used for experimental study follows:

Dependent Variables

Dependent variables was the behavioral measurement made by the experimenter, it is the out come which has been predicted to be dependent on the independent. The following dependent variables were selected for the experimental work.

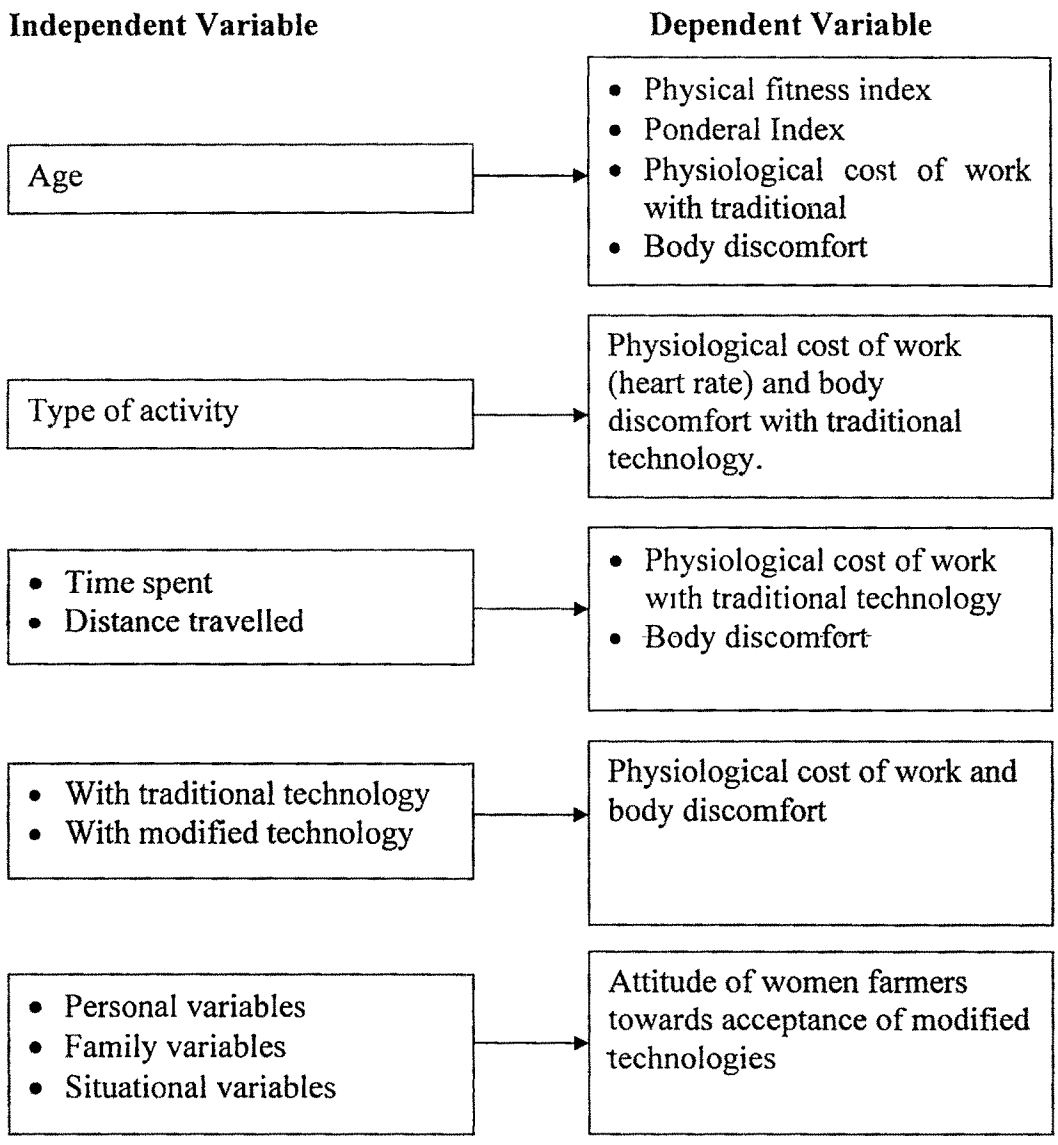


Figure 3.3(b) Hypothetical Relationships of Variables for Experimental Work

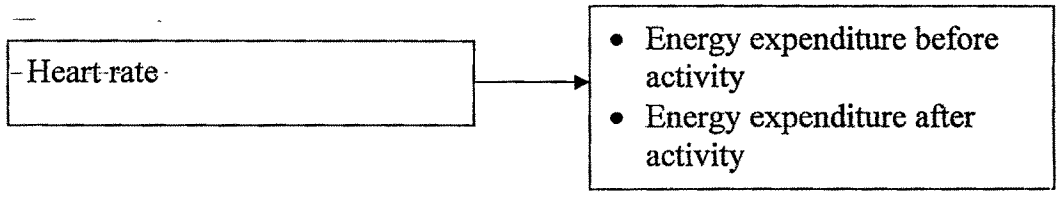


Figure 3.3(c) Hypothetical Relationship among Variables for Physiological Cost of Work

Physiological cost of work and body discomfort

Physiological cost was the dependent variable. Physiological cost refers to the amount of efforts put in by an individual while performing given task. Physiological cost of work in terms of heart rate, energy expenditure, muscular stress, postural stress was affected by several factors and it was postulated that a variety of personal i.e. worker related variables such as age, and work related variables, such as time spent and distance traveled would have a direct impact on physiological cost of work of women farmers. Introduction of modified technologies is expected to cause reduction in physiological cost of work Winter et al, 1985 Sharma 1993, Shalini 2000. There was however dearth of information regarding physiological cost of activities performed especially by women farmers. Body discomfort is also expected to be affected by work and worker related variables as well as improvement in technologies used by women farmers.

Physical fitness Index and Ponderal Index

These are important parameters for measuring health of women farmers which in turn affect their physiological cost of work. Many studies indicate that women farmers have average score an physical fitness index (Shalini 2000 and AICRP 1999). However, limited information was available regarding these variables which motivated the investigator to study the effect of these variables.

Attitude of Women Farmers towards Acceptance of Modified Technologies

Acceptance of modified technologies is defined as the degree of positive or negative effect associated with some physiological object. It was assumed that acceptance of modified technologies by women farmers may be affected personal, family and situational variables. The literature reviewed provides evidence that there exists dearth of information regarding attitude of women farmers towards acceptance of modified technologies. Thus it was considered to be important variables in the present investigation.

Independent Variables

Age of women farmers: Age of the women farmers was considered to be an important variable influencing physiological cost of work of women farmers. AICRP (1999), and 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 group age group (21-30 years) i.e., 107.90 beats/min and 8.54 kJ/min (AICRP, 2000-2001). 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 that the decrease in the number of body dimensions between the age 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).

Type of activities: Type of activities performed by women farmers seems to play a very important role in physiological cost of work experienced by them. According to Sharma and Thakur (1996) the activities like digging of land, weeding, hoeing, harvesting, thrashing and winnowing was more strenuous activities. Many studies showed a positive correlation between type of activity and physiological cost of work and body discomfort (Shalini, 2000). Lack of enough literature regarding types of activities, physiological cost of work and body discomfort has motivated the investigator to include this variable in the present study.

Time Spent and Distance Travelled: Time spent and distance traveled by women farmers in different activities plays an important role in physiological cost of work of women farmers. Chauhan (2001) reported that physiological cost of work in terms of heart rate, energy expenditure, T.C.C.W depends upon

the time spent and distance traveled 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 strength of this variable.

3.4 Operational Definitions

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

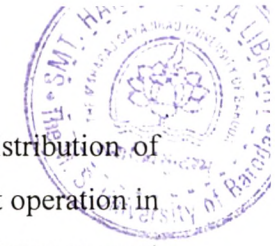
Women farmers: The women who possess her family's land / or work on the land of the others and her role is identified as agriculture and allied fields work i.e. crop production, livestock, horticulture and productive work.

Ergonomics: Ergonomics is operationally defined for the present study as analyzing of the normal operation of human body for better human inputs in activity of organic farming reducing the physiological cost of work and body discomfort.

Organic farming: Organic farming is defined as a system that attempts to provide a balance environment in which the maintenance of soil fertility the enhancement of natural process and cycles with only moderate inputs of energy and maintaining an optimum level productivity.

Type of activity: There were various types of activities which involved in organic farming. Only selected activities were taken for investigation as described below.

Digging of land: Digging of land was a mechanical process sometimes it was done by male members of the family. But mostly it was done by female farmers with the help of "Kudal".



Leveling of land: Leveling of land ensures a uniform distribution of seeds, manure and minimizes surface run off. It is a difficult operation in the hill region where the terraces are steeply inclined. The terraces must be supported by staining walls of stones, before the leveling of the soil can be taken up. The operation was performed by women farmers.

Sowing: Generally the sowing operation was performed by broadcasting or dropping the seed behind ploughing / line making with the help of women farmers which leads uneven and poor germination resulting in low production. Due to use of traditional technology it was most labour intensive tasks.

Application of manure: Manuring of the land after digging of land or after germination of seed was one of the most labour intensive. This operation was performed by women farmers and it was estimated that head loads of 18 – 20 kg manure are carried by women and spread in fields.

Interculture and hoeing: Light turning of the soil after the seeds have sprouted was necessary. Some times a blind hoeing even before the seeds have sprouted, was given to break the upper crust and ensure a good germination. This work was done by women with small hoe or kudal.

Weeding: Regular weeding of the crop was carried out to ensure better crop growth and yields, women perform this operation with small hoe / kudal.

Harvesting: The sickle was the tool used for harvesting which was a time labour intensive operation. The crop was harvested by women.

Threshing: A variety of ways adapted for threshing the harvest. Maize shelling was done extracting grain from cob through finger by the women farmers which was very labour intensive.

Winnowing: Threshed grain which was loosened from the ears or heads and are mixed with chaff, are winnowed by women farmers to separate the grains.

Ergonomic Parameters: For the present study the ergonomics parameters were seen in the terms of the physiological cost of work and anthropometric dimensions of the respondents.

Anthropometric dimensions: It is concerned with measurement of human body including body dimensions and the mechanical aspects of human body motions including considerations of range of frequency in an ergonomics model dimensions of body providing useful data for designing of tools and equipments. The selected body dimensions relevant to the present study are reported below

Stature: Vertical distance from the floor to the top of the head, standing in erect stretched posture.

Eye height: Vertical distance from the floor to the inner corner of the age.

Elbow height: Vertical distance form the floor to the most proximal point of the olecranon, tip of the ulna.

Knee height: Mid point of the patella (the knee bone) from the floor

Wrist circumference: At the styloid processes of radius and ulna (where the wrist band is born)

Sitting height: From floor to top of the head, sitting in normal relaxed posture.

Functional leg length: Horizontal distance between the most posterior point on the uncompressed buttocks and tip of the longest toe, when the legs are lifted from the floor, extended horizontally and stretched forward to the maximum, perpendicular to the trunk.

Forearm hand length: Most proximal point of the olecranon – tip of the ulna

Buttock knee length (sitting): Horizontal distance from the most posterior point on the uncompressed buttocks to the most anterior point on the knee (knee at right angle).

Knee height (sitting): Upper most point on the knee (at lower thigh) in sitting position

Thumb tip reach: Standing in front leaning posture, forward comfortable arm reaches to thumb tip from back.

Elbow grip length: Length of the hand grip from the elbow to the centre of the grip while holding a rod of 30 mm diameter.

Hand breadth: Maximum breadth across the palm with the arm at right angle to the long axis of the hand.

Functional grip reach: Length of the hand grip from the base of the back to the centre of the grip, while holding a rod of 30 mm diameter.

Fist length: Length of the hand grip in the same line of the long axis of the hand from the base of the palm to the tip of the fist, wherever found.

Hand grip length: Length of the hand grip, from the base of the palm to the centre of the grip, while holding a rod of 30 mm diameter.

Grip inside diameter: Maximum inside grip diameter, measured by sliding the hand down a graduated cone until the tips of the thumb and the middle finger remain touched to each other.

Wrist centre of grip: Length of the hand grip from the wrist to the centre of the grip, while holding a rod of 30 mm diameter

Physiological cost of work: It included heart rate (beats/min) energy expenditure (kJ/min), T.C.C.W (beats), muscular stress and postural stress involved in doing work.

Heart rate: Heart rate is defined as the number of heart beats / min.

Energy expenditure: The normal heart rate and increase heart rate during performance of task are measured then the energy expenditure is calculated with the help of the following formula.
Energy Expenditure = 0.159 x AV. Working heart rate (beat / min) – 8.72 (kJ/min)

Posture in work: Posture means maintaining the normal curve of the body while performing different activities. Posture in work means the

whole center of gravity remains as close as possible to that of normal standing erect condition.

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

Stress in work: Physical stage when the ability or efficiency to work reduces.

Physiological stress: The summation of stimuli that tend to upset the physiological of an individual. The degree of stress is measured by the degree of departure of the equilibrium state from the normal as for example increase in heart rate.

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

$$\text{Physical fitness Index} = \frac{\text{Duration of stepping (sec)}}{\text{Sum of 1st, 2nd and 3rd min recovery of heart rate}} \times 100$$

Blood pressure: Flow of blood between heart and the active musculature, during dynamic muscular effort, blood is squeezed out of the muscle due to contraction, but flows back easily during the subsequent relaxation.

Diastolic pressure: It is the lower level of blood pressure the period of relaxation of the heart during which the heart rate fills with blood.

Systolic pressure: It is the upper level of blood pressure the period of contraction during which heart pumps blood into the arteries.

Traditionally implements: Implements traditionally used for work.

Improved Implements: Implements designed on ergonomic principles keeping into mind the work, workers and the environment / work place.

3.5 Development of the Instrument

For descriptive data interview schedule was developed keeping in view the objectives of the study. It comprise of following section.

Section – I Contained the question to elicit information about the background characteristics of women farmers the household like age, education, type of family etc.

Section – II Dealt with the detail information regarding the extent of women's involvement in various types of activities. Type of technologies used for various activities, health problems and body discomfort experienced by women farmers, time spent, distance traveled and posture involved in various activities.

Section – III Contained the scale to measure attitude of women farmers towards acceptance of modified technologies.

Section – IV Dealt with anthropometrics dimensions, checklist to assess modified and traditional technologies. It also included various type of observation and record sheets for recording to physiological cost of activities in terms of heart rate, energy expenditure TCCW, postural stress and muscular stress. Body map and 10 point scale was also included for measuring body discomfort by women farmers during activities.

Development of Summated Rating Attitude scale

Attitude is a stable mental state regarding a phenomenon after years of experiences which could either be favourable or unfavourable (Edwards 1969, Best and Khan 1986). Researchers have shown that summated rating scale was

less labourious and less time consuming than the one developed by Thruston; Edwards and Kenny (1946).

The objective of assessing the attitude of women farmers towards acceptance of modified technologies required standardized scale to measure it. Therefore, a three point continuum rating scale was developed to measure the attitude of women farmers towards acceptance of modified technology. An exhaustive and detailed list of statement on various traditional and modified / improved technology which was used in organic farming in selected operation like digging of land, leveling of land, sowing, manure spreading etc.

Item Collection

Items relevant to study on various types of activities involved in organic farming in selected operation and extent of use of existing technology and acceptance of modified technology. The statements were formulated on the basis if literature reviewed and practical problems anticipated by women in relation to use and acceptance of traditional and modified / improved technology to be used most important consideration while collecting and framing the items was that it should be of the level of women farmers. The following criteria were borne in the mind while editing the statements regarding attitude of women farmers towards acceptance of modified technologies in organic farming.

1. The statements should be brief, simple, clear and direct.
2. The statements should be such that it cannot be interpreted in more than one way.
3. Each statement should contain only one complete thought.
4. The statement should be expression of desired behavior rather then expression of facts.
5. No statement should have double negative or conforming expressions.
6. Double barrelled statements should be avoided.

7. Statements should be in the form 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 the attitude scale

For establishing the content validity of attitude scale a list of 44 statements were given to a panel of 13 judges consisting of experts from department of Home Management. The M.S. University of Baroda, Department of Extension Education and Department of Family Resource Machinary and Power Engineering, College of Technology of G.B.Pant University of Pantnagar. The judges were specially requested to indicate the direction of the attitude as expressed by each statement. i.e. statement that favored the attitude towards acceptance of modified technology and vice – versa.

In addition they were also requested to indicate the clarity and relevance of the statements. The judge's responses were coded and tabulated. The following criteria served as a basis for the selection of statements.

1. Any statements reported as clear by eighty percent was included in the scale.
2. Those statements, where eighty percent or more of the judge's agreed on the direction of the attitude were included in the scale.
3. Any statements reported as ambiguous by three or more judge's were modified and rechecked at least by five judge's were included in attitude scale.

All the criteria were considered simultaneously. About 40 statements were chosen for inclusion in the attitude scale to be used for the present study.

Pilot study for Pretesting schedule

The instrument prepared was pretested on 33 randomly selected of women farmers of a non – sample village. Pilot study was done to check the clarity of the interview schedule and to established the reliability of attitude scale. Few changes were incorporated in the interview schedule 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 was no variable error at all in the measurement. So to ascertain the reliability of the instrument the following procedure was adopted.

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. Split half method was used for measuring the reliability of present study.

Split half method

In the split half method, the test was first divided into two equivalent halves and the correlation found for the half test. The test was to made into two sets of scores by combining alternate items in the tests. The first set of score 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.

Pearson product moment coefficient of correlation formula was used for calculating coefficient of correlation.

The reliability coefficient of the whole test was estimated from the Spearman Brown Prophecy formula.

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

Where

r_{II} = reliability coefficient of whole test

$r_{1/2}$ I/II = reliability coefficient of half test

Reliability of the attitude scale prepared to determined attitude of women farmers towards acceptance of modified technologies was found to be 0.73.

3.6 Selection of the Sample

Locale of the study

The present study has been carried out in Uttranchal State (Fig 3.4(a and b) Uttanchal is bounded by Tibet (China) in the north and Uttar Pradesh in the South, Nepal in the east and Himachal Pradesh in the west.

History

Uttranchal is mentioned in the ancient Hindu scripture as Kedarkand, Manaskhand and Himavant. It is also called the land of 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. The demand for a separted 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 Krangi Dal become 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 Dehradun. The percentage of literacy in Uttranchal is 72.78 percent in which percentage of male literacy and female literacy is 84.01 and 60.26 percent respectively.

Agriculture

About 90 percent 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 that one of the youngest states of India, Uttranchal was geared up to extend its traditionally strong agricultural base into organic farming. Uttranchal had 24 villages as dedicated to organic farming. Uttranchal is new called haven for organic farming in India.

Type of Crop

The hills are a very harsh environments the scalp slopes are difficult to farm. Agricultural land was scarce and scattered. The productivity of the small fields and terraces was low and they support an enormous number of people. From the view point of agriculture production. Only three hill zones up to an attitude of 3000 m, viz valleys, mid hills and high hills have relevance, the major cropping pattern of these zones was given as under.

Valleys: Paddy and soyabean in Karif season and wheat, potato and early winter vegetables in rabi season.

- **Mid hills:** Paddy, ragi (Mondua), Jhingora, Maize, Urd, Soyaben in Karif season and wheat barely and lentil in rabi season.

High hills: Ragi (Mandua), Jhingora, Maize, Soyaben, vegetables like pea, cauliflower, cabbage, tomato, radish in Kharif season and wheat in rabi season along with potato and other winter vegetables in ziad season (March to June).

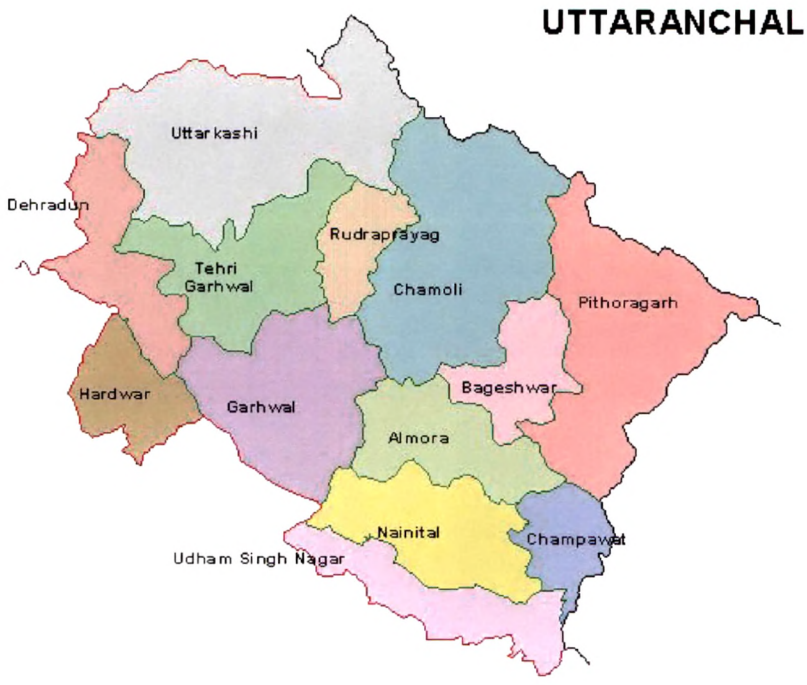


Fig 3.4 (a) Map of Uttaranchal

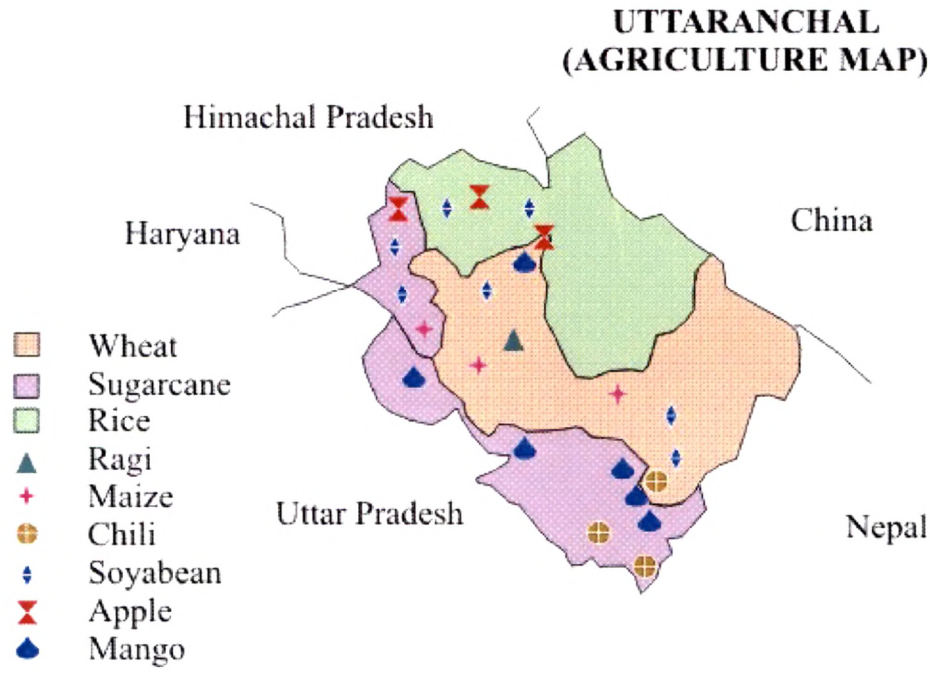


Fig 3.4 (b) Agricultural Map of Uttaranchal

Type of soil

Soils are created on land surface by weathering processes that include chemical, geological, hydrological, on the planet earth. The solid phases of soils are composed of two broad compounds. Inorganic (Mineral) and organic matter. The proportion between the mineral and organic components in soils can vary widely. Coarse textured soils contains ≤ 1% organic matters, whole organic coils contain up to 95% organic matter. The concentration of elements in the mineral and organic components varies from soil to soil and therefore it was important to know what types of soil was found in the areas and what type of technologies were suitable for that type of soil.

Calendar of Farming Activities of Women (an average estimate of activities in a year)

Month	**Activities**
November	Harvesting of Soyabean, Mandua, Urad, sowing of wheat, onion, garlic
December	Harvesting of Mustard, weeding in tomato, potato
January	No farming (snow fall), collection of fuel
February	- do -
March	Weeding in wheat, preparation fields for paddy, Jhingora, Maize
April	Sowing Paddy, Jhingaro, Maize and Harvesting of barely
May	Sowing Paddy, Soya bean, Mandua, Harvesting of wheat and Massor
June	Harvesting of summer vegetables
July	Weeding in Paddy, Mandua, Maize and Jhingora
August	Weeding in Paddy, Mandua and Jhingora
September	Harvesting Paddy, Maize and Jhingora
October	Harvesting in Paddy, preparation of field of wheat, sowing of wheat, chana, pea

Source – Dubey, U.K. 1992. Women and Rural Development in Uttranchal.

Sampling Design

The purposive cum convenience sampling design was followed to select the study area and respondents (Fig. 3.5). The stages comprised of selection of district, selection of blocks, selection of villages and selection of respondents.

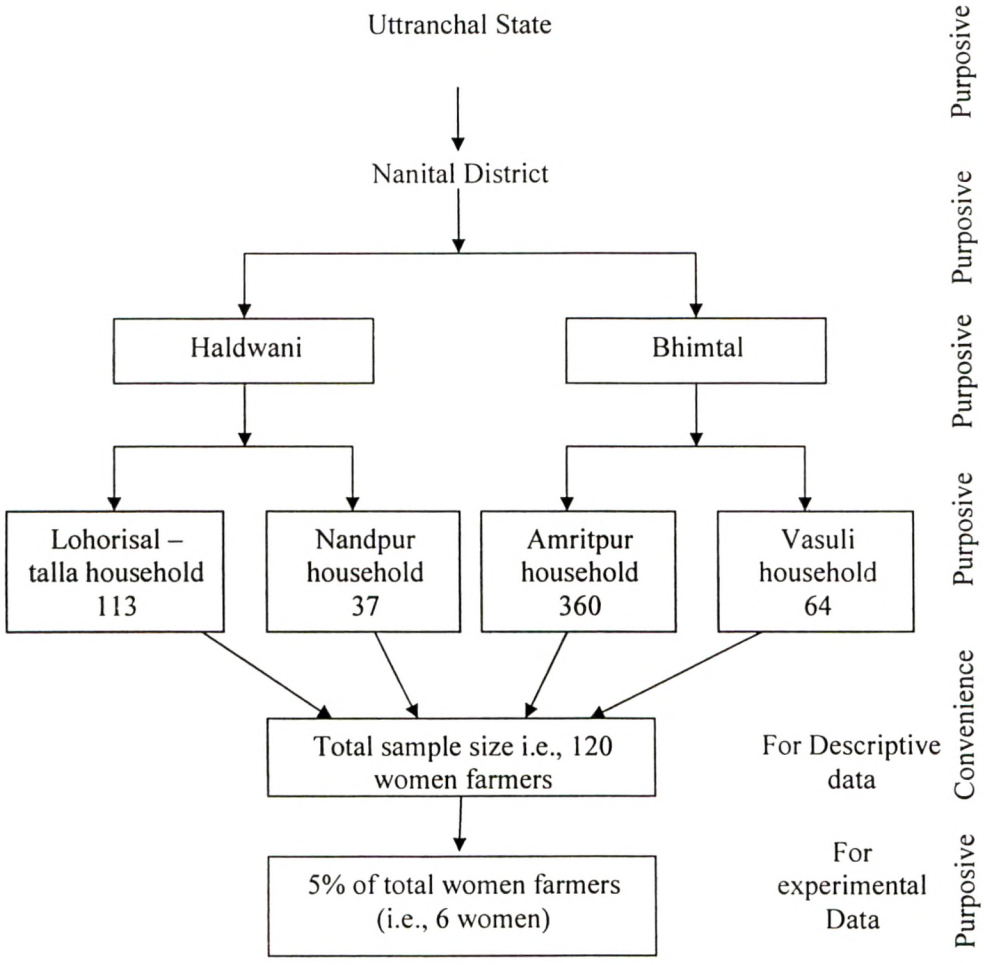


Fig 3.5 Schematic Representation of Sampling Design Adopted for the Study

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 was residing in villages. Mountain farmers have been using traditional technologies in various types of

agricultural activities. Geographical area covered by Nainital in 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 Nanital district was obtained from the district development offices, Nanital. The Nainital district consists of six blocks, out of which two block of Haldwani and Bheimtal were purposively selected because all the villages in these blocks were involved in organic farming and used traditional technologies.

Selection of villages

For selection of villages list of villages under Haldwani and Bheamtal were obtained. Hence from the list of villages four villages were purposely selected as these villages were convenient to approach.

Selection of Household

The total sample consisted of 120 women farmers. All the selected respondents were involved in organic farming, Selection of sample largely depended upon the intensity of organic farming activities undertaken at the time of investigation and those who were willing to respond. The unit of enquiry was the women farmers. The total sample size i.e., 120 women farmers was selected for descriptive data.

For the collection of experimental data 5 percent (of selected sample of 120 women farmers) i.e., 6 women were purposively selected on the basis of their physical fitness test. These women had normal blood pressure and also approximately same age, height, weight and body circumference.

The following were the additional precautions taken in selecting the subjects and the work situation:

- Pregnant women farmers were excluded form present investigation.

- The women farmers were prohibited from chewing pan or tobacco before and during the performance of the activities.
- The women farmers who were in first three days of menstrual cycle were not included.
- Only women farmers who were exhaustively involved in organic farming activities were selected.
- Activities were studied under normal work situations without any external interference of both men and materials.
- Rates of the estimated physiological cost of activities were normal.

3.7 Method of Data Collection

Descriptive Data: - For the descriptive study data was gathered personally by using interview method. A visit was made to each of the selected villages prior to data collection in order to establish a rapport with villagers prior to data collection and to ensure full confidence and co-operation from the respondents. The data was collected with the help of the interview schedule key informants were women farmers. In several cases, family members were also asked some of the specific question to cross check the answer. Respondents were interviewed in Hindi to maintain consistency while interviewing. Many times cross checking and cross questioning techniques for a particular response was used to get qualitative data.

Experimental data: The procedure followed for data collection for experimental work is reported below –

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)
2. Blood pressure (120 / 80 ±10)

3. Heart rate (70 – 90 beats / minute)
4. Physical fitness test (81 – 150)
5. Anthropometric measurements like height, weight and age (more or less same)

Besides this it was made sure that 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 experimental work and their physiological cost of work in terms of heart rate, energy expenditure muscular stress, and postural stress was recorded. For measuring the physiological cost of work these six women farmers spent same amount of time in performing the activity. Relevant anthropometric dimension were used for assessing the technologies.

Different parameters were taken for the measurement of physical fitness. (Fig 3.6) and physiological cost of work (Fig 3.8) of women farmers.

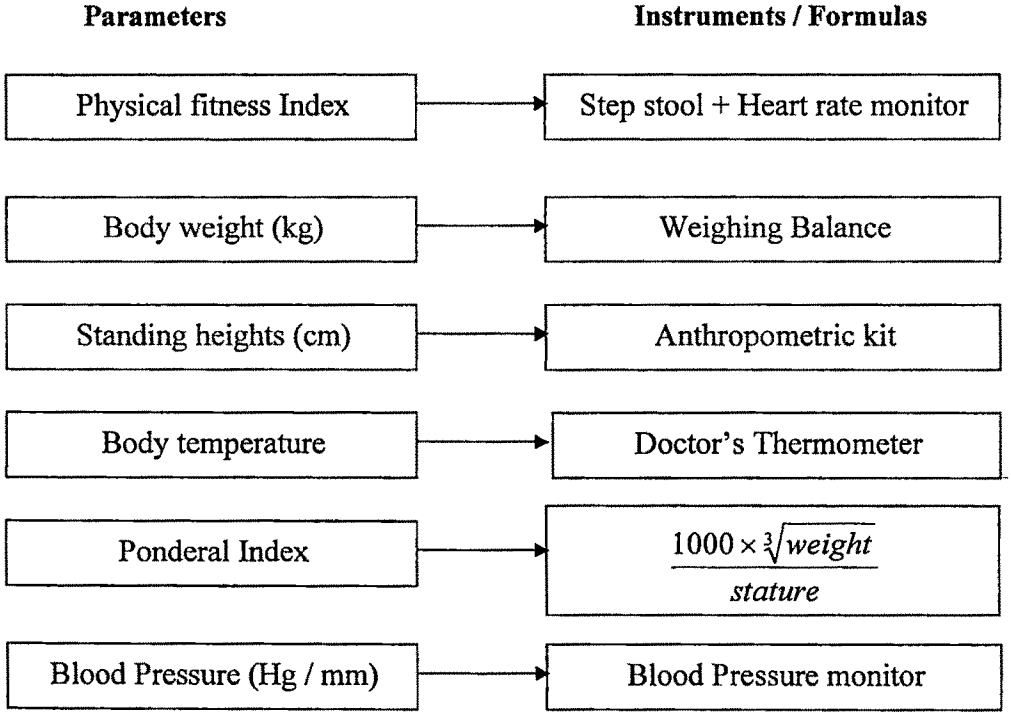


Fig 3.6 Equipment and Formula Used for Measuring Physical Fitness of Women Farmers

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.

Procedure: First of all women farmers were given enough rest and then her resting heart rate was measured with the help of Polar heart rate monitor. 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 respondents 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 and then the physical fitness score was calculated by using following formula. (Appendix I)

$$\text{Physical Fitness Index} = \frac{\text{Duration of stepping (sec)}}{\text{Sum of 1st, 2nd and 3rd min recovery of heart rate}} \times 100$$

Interpretation of Score

PFI Score	**Level of physical fitness**
Upto 80	Poor physical fitness
81 – 100	Low average
101 – 115	High average
116 – 135	Good
136 – 150	Very good
Beyond 150	Excellent

Source: - ACRIP Report (2001)

For Physical fitness: The procedure and instruments used for data collection are reported here.

Body weight: Weighing balance was used for taking the weight of women farmers. Weighing balance was set at zero point. Women farmers was asked to stand straight on the plat form with out shoes any support. Their weight was recorded in kilograms.

Standing height: Anthropometric kit was used for this purpose. Anthropometer is a precision instrument made up of four interconnecting sections of tubular metal that are engraved in millimeter intervals. Current models are square in cross section and are capable of measuring stature or other height from the floor and seated surface as well as straight length and distance up to 200 cm when completely assembled. The heights were noted by using movable slide that contain an adjustable perpendicular blade, which is placed in alignment with tightened lightly on the desired measuring points.

Body temperature: Body temperature of women farmers was recorded by thermometer. Thermometer was put under the tongue of respondents for three minutes after that thermometer was removed and her temperature was recorded temperature of women should not exceed beyond 99 °F.

Ponderal Index: The following formula was used

$$PI = \frac{1000 \times \sqrt[3]{weight\ in\ kg}}{stature\ in\ cm}$$

Interpretation of Score (PI)

Score	Body type
≤21.5	Ectomarph
21.5 – 25	Mesomarph
≥ 25	Endomarph

Physiological cost of work: For measuring physiological cost of activities and assessment of technologies used by women farmers. Formula and instruments were used (Fig. 3.8)

Heart Rate: For measuring physiological cost of work in terms of heart rate of women farmer, polar heart rate monitor was used. It was fully water resistant. For recording of heart rate of women farmers electrodes of heart rate monitor were wet thoroughly with water. The belt transmitter was tied as high under the pectoral muscle (breast) as was comfortable. It was tied in comfortable position to allow normal breathing. The women whose heart rate was to be measured should wear the polar heart rate monitor on her wrist and allowed to work in the field. Reading of heart rate was displayed on wrist watch. The investigator should wear time watch during recording of reading.

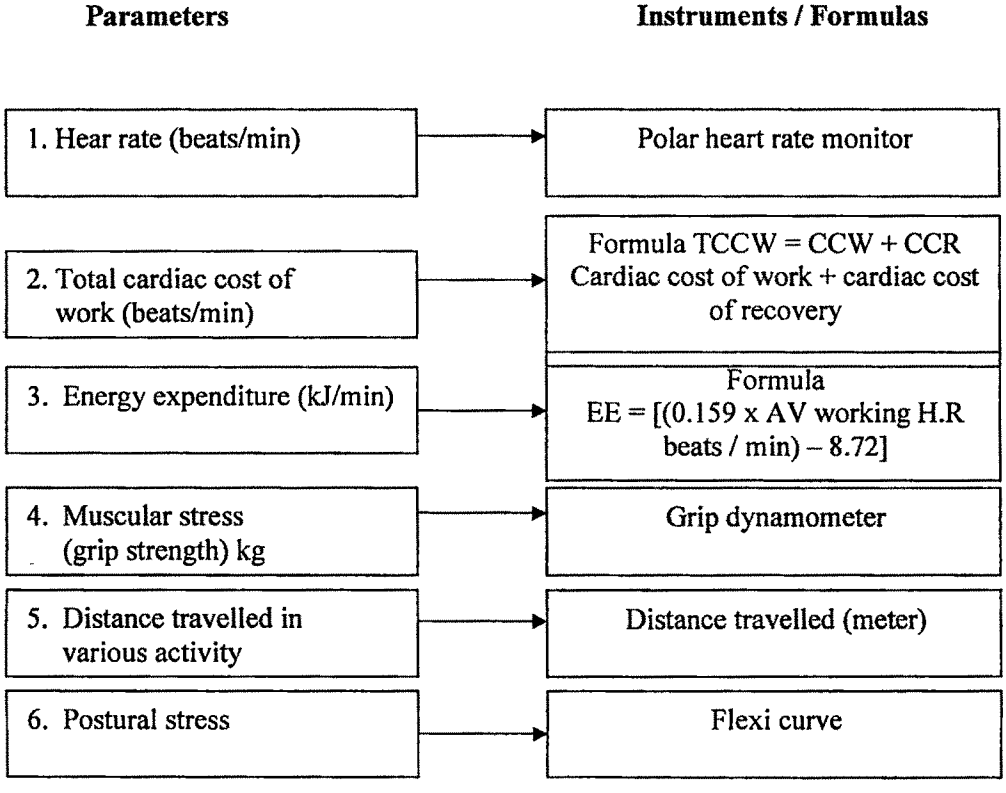


Fig 3.7 Equipments Used for Measuring Physiological Cost of Work of Women Farmers

Fig 3.8 Polar Heart Rate Monitor used for Physiological Cost (Heart Rate, beats/min)

Procedure: For measuring physiolgical cost of activities test code of Central Institute of Agriculture Engineering (CIAE) Bhopal was followed.

- Select the six subjects who were well accustomed to all operations (digging of land, sowing, weeding etc.)
- Examine the subject in operations.
- Train the subject in operation.
- Note the age, weight, height of the subjects and compute the mean and SD.
- The minimum length of test plot shall be twenty meter.
- The experiment was conducted using randomized block design were considered as sub treatment and activities performed by them were main treatment.
- The trials should be planned statistically.
- Each trail should be 15 minutes duration and three such trails should be carried out for each subject for each activity
- All the subjects should be informed about the purpose of the study to enlist her full cooperation.
- 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.
- 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.
- Allow the subject to calm for five minutes in sitting posture in the shed and measure the data for recovery duration. Don't allow the subject to talk and eat during resting period.
- Now ask the subject to perform the activity at the appropriate speed.
- Note / record, the data for heart rate of 6^{th} to 15^{th} minute of operation. If any reading is very different from other ones than delete reading and find out the average heart rate from remaining readings.

- After 15 minutes of operation the subject shall be given a rest of 15 minutes during that recovery pulse rate was counted.
- Repeat the procedure to get three sets of readings of all the selected subjects.

Total Cardiac Cost of work: It is a sum of cardiac cost of work and cardiac cost of recovery. It can be measured by applying following formula (ACRIP, 2001)

$$TCCW = CCW + CCR$$

Where,

TCCW = Total cardiac cost of work

CCW = Cardiac cost of work

CCR = Cardiac cost of recovery

Further,

CCW = Average Heart rate ($Av.HR_1$) x Duration

$Av.HR_1$ = Average Working heart rate (AWHR) – Average Resting H.R x Duration

CCR = Average Working heart rate ($AvHR_2$) x Duration

$Av.HR_2$ = Average Recovery Heart Rate – Average Resting H.R.

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 worker performing a job was calculated from cardio – vascular stress rate. The following formula is used for calculating energy expenditure. (ACRIP, 2001)

Energy expenditure (kJ/min) = 0.159 x Average heart rate (beats / min) – 8.72

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

Procedure: The subject whose grip fatigue was to be measured was 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. (ACRIP, 2001)

Grip fatigue was calculated by applying following formula

$$\text{Percentage increase in Grip Strength} = \frac{Sr - Sw}{Sr} \times 100$$

Where Sr = strength of muscles at rest

Sw = strength of muscles after work.

Distance Travelled: Distance travelled by women farmers was measured in meters during various agricultural activities.

Postural Stress: Postural stress of women farmers was measured with the help of flexi curve. To measures the postural stress women farmers like digging of land, sowing, weeding harvesting etc. Attempt was made to analyze the data in such a way, where some evidences could be drawn about the postural stress due to over size performance of various type of activities by using traditional technologies.

Flexi curve is a light plastic wire which can be moulded in any direction. Postural analysis of lumbosacral region during performance the activity was measured with the help of flexi curve. We can find the point of bending and angle of deviation from the normal angle of the body while performing the task, with the help of flexi curve.

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 give 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	20 – 30 years
Middle	31 – 40 years
Old	above 40 years.

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

Illiterate

Primary School

High School

Intermediate

Graduate

Occupation of farmers It was categorized as

Part time

Full time

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

Small	less than 5 members
Medium	5 to 10 members
Large	Greater then 10

Size of land holding Land holding refers to the, 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 (2001) size of land holding was categorized as

Marginal or no land	less then or equal to 1.0 hectare
Small Farmer	2.0 – 4.0 hectare
Medium Farmers	4.0 – 10 hectare
Large Farmers	Greater then or equal to 10 hectare

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

Low income level	Upto Rs. 1700
Medium income level	Rs. 1701 to 4200
High income level	Rs. 4201 to 8400

Livestock possession: It refers to number of live stock possessed by women farmers

Small	less then 6
Medium	6 – 10
Large	Greater then 10

Attitude: The respondents were categorized as having favorable neutral or unfavorable attitude on the basis of scores obtained by them.

Attitude Scale			**Category**	**Score Range**
Agree	-	3	Favourable	40 - 66
Undecided	-	2	Neutral	31 – 39
Disagree	-	1	Unfavourable	20 - 30

Body discomfort: Discomfort was the body pain arising as a result of the excessive stress on muscles due to the effort involved in the activity. Sometimes it was also called as overall discomfort or simply discomfort. For measuring the body discomfort intensity single noun verbal rating scale was adopted (Straker, 1997). It was categorized as

Body Discomfort		**Score range**
Mild	1	12 – 20
Moderate	2	21 – 28
Severe	3	29 – 36

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 analyzing the following information.

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

Relational Statistics: Two way ANOVA - test (split plot design) (Appendix – IV), simple t - test, Karl Pearson product moment correlation was applied to find out the relationship between variables.