Chapter 5

Research Methodology

The deliberation on the methodology has been made to understand the concept, methods and techniques which utilized to design the study, collection of information, analysis of the data and interpretation of the findings for revelation of truths and formulation of theories. This present chapter deals with the method and a procedure used in the study and consists of eight main parts.

I. Locale of research	II. Sampling techniques
III. Pilot study	IV. Preparation of interview schedule
V. Pre-testing of schedule	VI. Techniques of field data collection
VII. Attributes and their measurement	VIII. Statistical tools used for data analysis

I) Locale of research

Selection of district

Keeping in view agriculturally, socio-economically backward and major climate change impact on rice production area having their major source of income from rice production through SRI (System of rice intensification) and conventional method of

cultivation, Bhandara district in Maharashtra was selected for the research study.

Selection of blocks and villages

Bhandara itself as a block of Bhandara district and Sakoli block purposively selected for the study. The reasons behind such a selection is a follows-

(1) Selection of Bhandara block and villages- The researcher's close familiarity with the area, the people, their culture and the locale dialect provided added weight age facilitating the study and the process of collecting data. The concern area was easily accessibility to the researcher in terms of transportation and place of residence so, on the basis of that Four villages from this block were selected namely (1) Dhargaon (2) Khokarla (3) Tawepar and (4) Satona.

(2) Selection of Sakoli block and villages- Close familiarity with the area, and because got the information from KVK, Sakoli that lots of farmers they were doing both Conventional and particularly SRI farming which is under the consideration of my study. So, on the basis of that four villages from this block were selected namely (1) Mokhe (2) Virshi (3) Bodara and (4) Sendurwafa.

II) Sampling techniques

Purposive as well as simple random sampling techniques were adopted for the study. For selection of State, District, Blocks and Villages purposive sampling techniques was adopted because the

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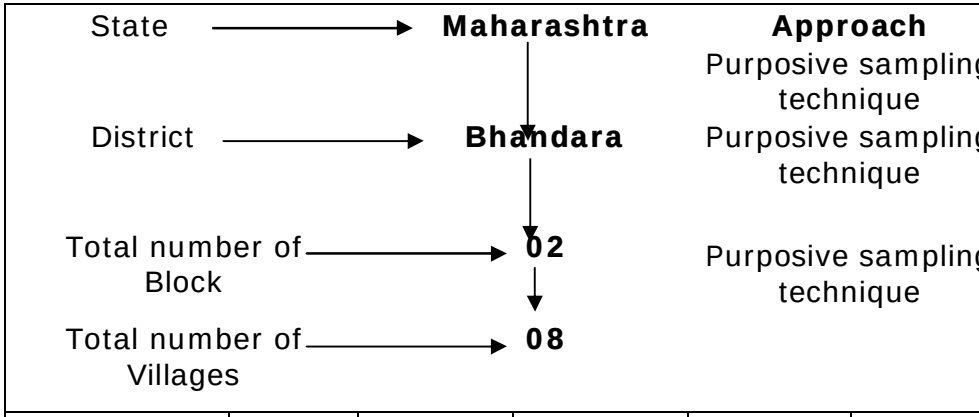
area was ideal with respect to the problem, convenient for researcher and having the infrastructural facilities and in case of selection of farmers or respondents simple random sampling technique was taken up.

Among 200 farmers (Conventional method/SRI method) , 100 farmers have been randomly selected from the selected villages of Sakoli block where SRI method is predominantly used and another 100 farmers have been randomly selected from the selected villages of Bhandara block where only conventional method is used.

Diagrammatic representation of sampling technique and sampling design



Farming method	Block	Village	No. of adopted respondents	Total adopted respondent	Approach
Convention	Bhand	Dhargaon	25	100	Simple

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al method	ara	Khokarla	25		random technique.
		Tawepar	25		
		Satona	25		
SRI method	Sakoli	Mokhe	25	100	Simple random technique
		Virshi	25		
		Bodara	25		
		Sendurwafa	25		
Total selected respondent				200	

III) Pilot study

Before going to collect sample area of work or investigation, pilot study was conducted to understand the area, its people, institution, communication, extension system and attitude of people. Basic situational and background information was collected during period of pilot study from the different sources including Panchayat office, Block office, Argil. Development office and KVK Sakoli.

IV) Preparation of the interview schedule

On the basis of findings of pilot study a preliminary interview schedule was formed with the help of literature, discussion with farmers and by the assistance of Chairman of Advisory Committee. The interview schedule consisted of two major parts according to the specific objectives of the study.

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V) Pre-testing of schedule

Before starting final data collection, entire schedule was pretested for elimination, addition and alternation with non-sample respondents of the study area.

VI) Techniques of field data collection

Relevant primary data were collected with the help of schedule constructed for the study. In the state of Maharashtra, Bhandara block of Bhandara district, data were collected during October to December 2013for conventional method of rice in the light of climate change and the data were collected during January to march 2014 for SRI method of rice in the light of climate change. The data was collected by the researcher with the help of interpreter in some places.

Secondary data relating to the demographic features of the state has been collected from published materials so far available from the State Agricultural Department, KVK, Census reports, Directorate of Economics and Statistics of Maharashtra state. Data related to the climate were collected from available from the internet and some important data were collected from literature and books.

VII) Attributes and their measurement

After reviewing various literature related to the field of study and consultation with the respected chairman of Advisory Committee and other experts, a list of variables was prepared. On the basis of selected variables, a schedule was formed.

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Independent variables and dependent variables with their empirical measurement are as follows:

Operational definitions of independent variables

Age (X_1)

It refers to chronological age of respondent at the time of interview has been considered.

Education (X_2)

Education is the factor that has been conceived in terms of acquisition of knowledge and skill formality in school. The values ascribed the class in which the respondent is studying.

Structured schedule developed it had been measured according to the educational class attainment of the respondent. The education had been divided into five categories that is Illiterate, Primary, Secondary, Higher secondary, Graduate and above. It had been measured with the help of scale developed by Pareek and Trivedi (1964) scale is socio-economic status (rural) and the weightages had been given as Illiterate-(0), Primary-(1), Secondary-(2), Higher secondary- (3), Graduate and above - (4).

Family education status (X_3)

Family education status denotes the overall education status of the family members. Structured schedule developed it had been measured according to the educational class attainment of the respondent.

(Computation of family education status)

Ex- Total member in family: 10

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Member up to 4 year of age: 2

So, effective family size: 8

Educational score of the family members:

Education level	Scale score	Frequency	Total score
(1)Graduate and above	4	0	0
(2)Higher secondary	3	0	0
(3) Secondary	2	4	8
(4) Primary	1	4	4
(1) Illiterate	0	0	0
Total		8	12

So, Family education status= Total educational score/Effective Family size
= 12/8= 1.8

Primary occupation (X_{41})

It refers the primary source of income of the selected respondent. By given rank to the respondent and add it according to their source of income primarily. The scale has been ascribed according to the judge's ratings. The schedule developed for the study. Labour (1) / Caste Occupation (2) / Business (3) / Independent profession (4) /Cultivation (5) / Service (6).

Secondary occupation (X_{42})

It refers the secondary source of income of the selected respondent. By given rank to the respondent and add it according to their source of income secondarily. The scale has been ascribed according to the judge's ratings. The schedule developed

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for the study. Labour (1) / Caste Occupation (2) / Business (3) / Independent profession (4) /Cultivation (5) / Service (6).

Caste (X_5)

A caste is one where by a society is divided into number of self-contained and completely segregated units, the mutual relations between which are virtually determined in a graded scale. As many of the castes mentioned by Parik and Trivedi (1964) were not found in Maharashtra, the following scores were given to the castes categories mentioned below, after discussion with experts.

General-(4), Other backward classes-(3), Scheduled caste-(2), Scheduled tribe-(1).

Family type (X_6)

The attribute family type had been operational zed as the family type of our rural system. The family type had been divided in to two categories of the social system that is single family and joint family. It had been measured with the help of development of Pareek and Trivedi (1964) scale is socio-economic status (rural) and the weightages had been given as Single family-(1) and Joint family-(2).

Family size (X_7)

It denotes the total no. of persons living in the respondents' house under a single household.

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Family income (primary) (X_{81})

Income from primary sources of occupation in rupees per year divided by number of family member was taken in to account.

Family income (secondary) (X_{82})

Income from secondary sources of occupation in rupees per year divided by number of family member was taken in to account.

Farm size (X_9)

Farm size is a measure of farm business. The actual area under cultivation in hectare was taken as a measure of farm size.

Social participation (X_{10})

The attribute social participation had been operational zed as the social participation of the respondent in the social organization. It had been measured with the scale developed by the Pareek and Trivedi (1964) and weight ages as member of one organization, member of more than one organization, office holder and wider public leader. Socio-economic status (rural) and the weight ages had been given as No any participation (0), Member of one organization-(1), Member of more than one organization-(2), Office holder-(3) and Wider public leader-(4).

Risk orientation (X_{11})

In general, farming is characterised by many uncontrollable factors such as rainfall, drought, insect pests and diseases, price fluctuation etc. therefore, regardless of the degree of information possessed by the farmers, there are risks involved in farming.

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It was measured with the help of risk preference scale developed by Supe (1969). He defined risk preferences as the degree to which a farmer is oriented towards risk and uncertainty and has the courage to face the problem in farming.

The scale consisted of 5 Items were rated in five point response categories ranging from 'strongly agree' to strongly disagree' there were three positive items and two negative items in the scale. The scoring for the positive items was Strongly agree-7, Agree-5, Undecided-4, Disagree-3, and Strongly disagree-1. For the negative items the reverse way of scoring was followed.

Index of farm mechanization (X_{12})

Use of farm machinery saves human and animal labour and ensures performance of various farm operations more efficiently. It enables the farmer to make timely farm operations and provides scope for better management of the farm. Farm mechanization index was calculated by the formula developed by Samanta (1977). The index had 12 items which were given weights varying from 3 to 1, according to their degree of contribution towards farm mechanization. One more item 'thresher' with weightage 2 was added to the index of farm mechanization by Singh (1981).

$$\text{Farm mechanization index} = \sum_{I=1}^{N} wj \times tj$$

where, Wj= Weightage of the item,

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tj= Total period in years the ith item had been used, and

N= Total number of items selected by farmer.

Cropping intensity (X_{13})

Cropping intensity is an indicator of the intensity to which farm lands are used for raising crops. It also indicates the rate of turnover from farm land as a production resource. The cropping intensity was calculated by the formula

$$\text{Cropping intensity} = \frac{\text{Total annual cropped area in hectare}}{\text{Size of holding in hectare}} \times 100$$

Selling% (X_{14})

The attribute selling % had been operational zed as the selling of produce out of from the total production of rice.

Debt (X_{15})

Debt of selected respondents refers to money/loan have been taken from bank or from any other finical institution for rice cultivation whichever was pending during the major part in the year. The scale has been ascribed according to the judge's ratings. The schedule developed for the study. Yes-(1), No-(0).

Migration (X_{16})

Migration of selected respondents refers to move from one place to another place for their survival due to heavy loss in rice production. The scale has been ascribed according to the judge's ratings. The schedule developed for the study. Yes-(1), No-(0).

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Mass media exposure (X_{17})

Mass media exposure is the degree to which an individual is exposed to the mass media with respect to new innovation in agriculture, economic activity and other information. Mass media exposure was therefore measured by ascertaining from the respondents about the frequency of watching television, listening to radio programmes, reading newspaper as well as other types of exposures. This was measured with the help of scale developed by Singh (1972).

Source	Always (4)	Very often (3)	Sometimes (2)	Very few (1)	Never (0)
Radio					
Television					
Educational film					
News paper					
Agril. magazine					
Agricultural exhibition					

Utilization of personal cosmopolite sources of information (X_{18})

It refers to measure the degree of utilization of personal cosmopolite sources of information each respondent was asked to indicate on a 3-point continuum as to how often he got information about climate change from each of the sources. The scoring procedure for the responses was Always-(2), Sometimes-(1) and Never-(0). The score for an individual respondent was obtained by adding the score over different sources.

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Statement	Always (2)	Sometimes (1)	Never (0)
i) I use to travel outside my village during last year to visit place.			
ii) I personally visited agriculture expert for his advice about my occupation.			
iii) I use to contact with agriculture expert who visited my village for his advice/help during last year.			
iv) I use to visit farmers of outside my village and seek their advice.			
v) I use to invite people who visited my village for discussion about village development during last year.			

Utilization of personal localite sources of information (X_{19})

It refers to measure the degree of utilization of personal localite sources of information each respondent was asked to indicate on a 4-point continuum as to how often he got information about climate change from each of the sources. The scoring procedure for the responses was Very often-(3), Often-(2), Sometimes-(1) and Never-(0). The score for an individual respondent was obtained by adding the score over different sources.

Source	Very often (3)	Often (2)	Sometimes (1)	Never (0)
i) Local agents				
ii) Local leader				
iii) Friends/relative/neighbors				

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iv) Experienced/ progressive farmers				

Contact with extension personal (X_{20})

It refers to measure the degree of Contact with extension personal each respondent was asked to indicate on a 5-point continuum as to how often he got information about climate change from each of the sources. The scoring procedure for the responses was Most often-(4), Often-(3), Sometimes-(2) Rarely-(1) and Never-(0). The score for an individual respondent was obtained by adding the score over different sources.

SN	Extension worker	Most often (4)	Often (3)	Sometimes (2)	Rarely (1)	Never (0)
1	A.D.O.					
2	B.D.O.					
3	Agril supervisor					
4	Agril officer (T & V)					
5	Agril scientist					
6	Fertilizer dealer					
7	Private company(seed/pesticide)					

Seed rate % (X_{21})

It has been conceived in terms of level of adoption of seed kg/h. As per the govt. seed required for conventional/traditional method-40kg/h and for SRI method-5kg/h. Seed rate was calculated by following formula:

$$\frac{\text{Adopted seed rate kg/h} \times 100}{\text{Recommended seed rate kg/h}}$$

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Fertilizer% (X_{22})

It has been conceived in terms of level of adoption of amount of fertilizer dose (NPK) kg/h. As per the govt. (NPK) dose required for conventional method-100 kg N, 50 Kg P and 50 kg K and for SRI method-same as per conventional method but including organic manure like- Farm yard manure, Compost, Vermicompost, Fresh cow dung, Green manuring crops and plant residue in the form of NPK.

Fertilizer was calculated by following formula:

$$\frac{\text{Adopted fertilizer dose kg/h} \times 100}{\text{Recommended fertilizer dose kg/h}}$$

Pesticide% (X_{23})

It has been conceived in terms of level of adoption for amount of pesticide dose required kg/h. As per the govt. pesticide dose required for conventional method- (Fungicide-Tricyclazole WP 75-0.6g/litre) and for SRI method- (Insecticide-Carbofuron 3g @ 1kg (a.i) active ingredient per hectare.) for the particular pests attack on both method of rice cultivation. Pesticide was calculated by following formula:

$$\frac{\text{Adopted pesticide dose kg/h} \times 100}{\text{Recommended pesticide dose kg/h}}$$

Weed management% (X_{24})

It has been conceived in terms of level of adoption for amount of herbicide dose required kg/h. As per the govt herbicide dose required for conventional and SRI method-1.5 kg (a.i.) active

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ingredient per hectare for weed control. Weed management was calculated by following formula:

$$\frac{\text{Adopted herbicide dose kg/h} \times 100}{\text{Recommended herbicide dose kg/h}}$$

Water management% (X_{25})

It has been conceived in terms of level of adoption for amount of water required during every crop growth stages. As per the govt. amount of water required during crop growth stages were follows. (1) For conventional method- seedling stage-2.5 cm water level, dough stage-up to 5 cm water level, ten days before grain filling-10 cm. (2) for SRI method-55 days from transplanting water should not be stagnant, irrigation should be provided only to moist the soil in the early period of 10 days, until panicle initiation stage 2.5cm water level, maintain 3-5 cm water level from booting stage up to three weeks. Water should be given in this way that the land must be continuously in intermittent situation.

Water management was calculated by following formula:

$$\frac{\text{Adopted water level in cm} \times 100}{\text{Recommended water level in cm}}$$

Irrigation index (X_{26})

Availability of irrigation water in itself increases agricultural production. It also provides opportunity to use modern inputs which contribute towards more yield and income. Irrigation index was calculated by following formula:

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$$\text{Irrigation index} = \frac{\text{Total area under irrigation in hectare}}{\text{Size of holding in hectare}} \times 100$$

Sowing time (X_{27})

It refers the actual time of sowing the rice seed. By given rank on the basis of time duration for sowing the scale has been ascribed according to the judge's ratings. The schedule developed for the study. For Conventional method-15June-25 June-(1), 26 June- 5 July-(2), 6 July-15 July- (3) and 16 July-25 July- (4). For SRI method-15 July- 23 July - (1), 24 July- 31 July - (2) and 1 August- 8 August- (3).

Varietal change (X_{28})

It refers the changing the variety every year due to the various reason. By given rank on the basis of changing the variety every year due to climate change or due to any other reason. The scale has been ascribed according to the judge's ratings. The schedule developed for the study. For both method- varietal change Due to climate change - (1) and Other reason- (0).

Farm power (X_{29})

The attribute farm power had been operationalized as the farm power of the respondent in the social system. It had been measured with the scale developed by the Pareek and Trivedi (1964) and weightages as the no drought animal, 1-2 drought animal, 3-4 drought animal or 1 or more prestige animal, 5-6 drought animal. Socio-economic status (rural) and the weightages had been given as No drought animal –(0), 1-2

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drought animal –(2), 3-4 drought animal or 1 or more prestige animal –(4), 5-6 drought animal –(6).

Change in rainfall pattern over last 20 year (X_{30})

It refers the change pattern in rainfall (increase or decrease) on the basis of farmer perception. By given rank on the basis of change in rainfall pattern over last 20 year. The schedule developed for the study. Scale has been ascribed according to the judge's ratings. The response of farmer has been taken on the scale value 0-10.The range of score was from 0 to 10.

Change pattern in temperature (day/night) over last 20 year (X_{31})

It refers the change pattern in temperature (increase or decrease) on the basis of farmer perception. By given rank on the basis of change pattern in temperature (day/night) over last 20 year. The schedule developed for the study. Scale has been ascribed according to the judge's ratings. The response of farmer has been taken on the scale value 0-10.The range of score was from 0 to 10.

Change pattern in weather disaster over last 20 year (X_{32})

It refers the change pattern in weather disaster (increase or decrease) on the basis of farmer perception. By given rank on the basis of change pattern in weather disaster over last 20 year. The schedule developed for the study. Scale has been ascribed according to the judge's ratings. The response of farmer has been

taken on the scale value 0-10.The range of score was from 0 to 10.

Change in seasonal pattern over last 20 year (X_{33})

It refers the change pattern in seasonal pattern (increase or decrease) on the basis of farmer perception. By given rank on the basis of change in seasonal pattern over last 20 year. The schedule developed for the study. Scale has been ascribed according to the judge's ratings. The response of farmer has been taken on the scale value 0-10.The range of score was from 0 to 10.

Change pattern in insect/pests and diseases over last 20 year (X_{34})

It refers the change pattern in insect/pests and diseases (increase or decrease) on the basis of farmer perception. By given rank on the basis of change pattern in insect/pests and diseases over last 20 year. The schedule developed for the study. Scale has been ascribed according to the judge's ratings. The response of farmer has been taken on the scale value 0-10.The range of score was from 0 to 10.

Change pattern in weed problem over last 20 year (X_{35})

It refers the change pattern in weed problem (increase or decrease) on the basis of farmer perception. By given rank on the basis of change pattern in weed problem over last 20 year. The schedule developed for the study. Scale has been ascribed according to the judge's ratings. The response of farmer has been

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taken on the scale value 0-10.The range of score was from 0 to 10.

Operational definitions of dependent variables:

Net return from rice (Y_1)

Net return from the rice was the major source of livelihood for the selected respondent. The attribute net return from rice was calculated by gross return from rice production minus total cost for rice production management.

Expenditure on health care (Y_2)

It is the income which has been got from the selling of produce in the light of climate change and utilized on health care. It is conceived as the expenditure incur after health and its related concerns. It was calculated by dividing the yearly expenditure on health care in terms of rupee divided by total family members.

Livelihood in this study has been focussed through the variable net return from rice and expenditure on health care which has been affected by climate change or by climatic parameters.

VIII) Statistical tools used for data analysis

Mean

The mean is the arithmetic average and is the result obtained when the sum of the value of the individuals in the data is divided by the number of individuals in the data (Pause and Sukhatme, 1967). Mean is the simplest and relatively stable measure of

central tendency. The mean reflect and is affected by every score in the distribution. Thus extreme scores affect the mean.

For social action purpose, a mean may not provide a realistic picture of the situation. For example, the high income of a few big farmers may level off the poor income of the large number of marginal farmers.

When the data are expressed in a frequency distribution (grouped), the mean is calculated by the formula:

$$\bar{X} = \frac{\sum f.x}{N}$$

Where, X= mean of the distribution

f= frequency of the class

x= class value or midpoint of the class interval

N= number of observations

Standard deviation

Standard Deviation is the square root of the arithmetic mean of the square of all deviation, the deviations being measured from the arithmetic mean of the distribution. It is commo9nly denoted by the symbol σ (sigma). It is less affected by sampling errors and is a more stable measure of dispersion. The standard deviation of the data grouped in the form of a frequency distribution is computed by the formula:

$$\sigma = \sqrt{\frac{\sum f.d2}{N}}$$

Where,

f= frequency of the class

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d= deviation of the mid-value of the class from the population mean

N= total number of observations.

Co-efficient of variation

A measure of variation which is independent of the unit of measurement is provided by the co-efficient of variation. Being unit free, this is useful for comparison of variability between different populations. The co-efficient of variation is standard deviation expressed as percentage of the mean and is measured by the formula:

$$\text{Co-efficient of variance (C.V.)} = \frac{Standard\ Deviation}{Mean} \times 100$$

Correlation

When an increase or decrease in one variant is accompanied by an increase or decrease in the other variant, the two are said to be correlated and the phenomenon is known as correlation. Correlation co-efficient(r) is a measure of relationship between two variables which are at the interval or ratio level of measurement and are linearly related. A person product moment (r) is computed by the formula:

$$rxy = \frac{N\sum \times Y - (\sum \times)(\sum Y)}{\sqrt{[N\sum \times 2 - (\sum \times)2][N\sum Y2 - (\sum Y2)]}}$$

Where, X and Y =original scores in variables X and Y

N= number of paired scores

∑×Y= each Y multiplied by its corresponding Y, then summed

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$\sum x$ = sum of X score

$\sum x^2$ = each X squared, then summed

$(\sum x)^2$ = sum of X scores, squared

$\sum Y^2$ = each Y squared, then summed

$(\sum Y)^2$ = sum of Y scores, squared

$\sum Y$ = sum of y score

The range of correlation co-efficient is between -1 to +1. This means that -1 is perfect negative correlation and +1 is perfect positive correlation. A perfect correlation is, however, achieved. An idea of negative and positive correlation is given here. If the number of errors increases with increase in typing speed, it indicates positive correlation. If the number of correct words decreases with increase typing speed it is indicating of negative correlation. A correlation co-efficient to be acceptable should be statistically significant. Otherwise no significant relationship exists between the variable.

Path analysis

The term was first introduced by the biologist Sewal Wright in 1934 in connection with decomposing the total correlation between any two variables in a causal system. The technique is based on a service of multiple regression analysis with the added assumption of the causal relationship between independent and dependent variable.

Path analysis makes use of standardized partial regression co-efficient (known as beta weights) was effect co-efficient. In linear

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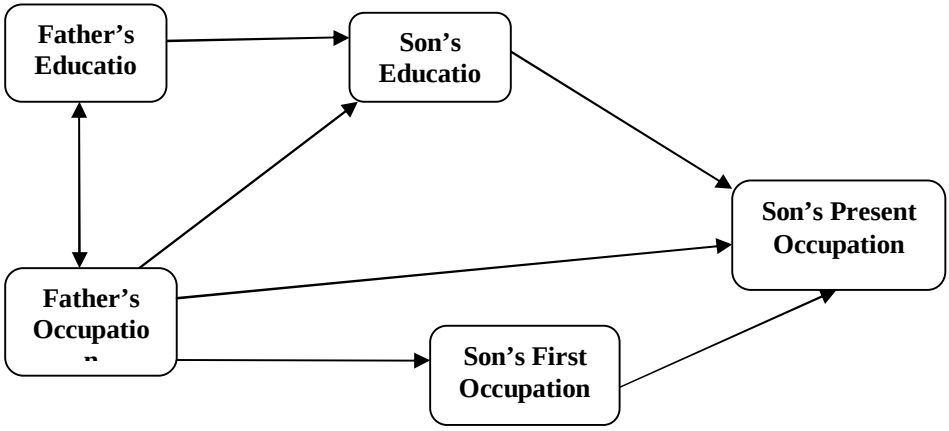
additive affects are assumed, then through path analysis simple set of equations can be built up showing how each variable depend on preceding variable. The main principle of path analysis is that a correlation coefficient between two variables, or a gross or overall measure of empirical relationship can be decomposed in a series of parts: separate parts of influence leading through chronologically intermediate variable to which both the correlated variable have links.

The merit of path analysis in comparison to correlation analysis is that it makes possible the assessment of the relative influence of each antecedent or explanatory variables on the consequent or criterion variables by first making explicit the assumption, underlying the causal connections and then by elucidation the direct affect the explanatory variables.



An illustrative path diagram showing inter relationship between father's education, father's occupation, son's first and son's present occupation can be shown as;

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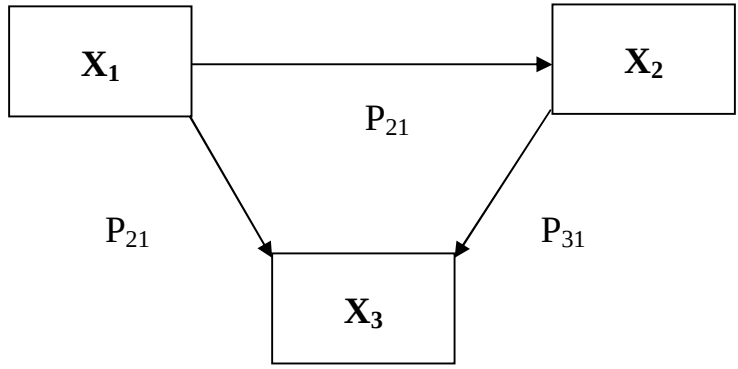
The use of the path analysis technique requires the assumption that there are linear additives, a symmetry relationship among a set of variables which can be measured at least on a quest interval scale. Each dependent variable is regarded as determined by the variable preceding it in the path diagram, and a residual variable defined as uncorrelated with other variables, is postulated to account for the unexplained portion of the variance in the dependent variable. The determining variables are summed for the analysis to be given (exogenous in the model).

We may illustrate the path analysis technique in connection with a simple problem of testing a causal model with three explicit variables as shown in the following path diagram:



Path diagram (with three variables)

The structural equation for the above can be written as:

$X_1 = e_1$

$X_2 = P_{21}X_1 + e_2 \quad = px + e$

$X_3 = P_{53}X_2 + P_{32}X_2 + e_3$

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X_1 and X variable are measured as deviation from their respective means. P_{21} may be estimated from the simple regression of X_2 on X_1, i.e.,$b_{21}X_1$ and P_{31}may be estimated from the regression of X on X_2 and X_1 as under:

$X = P_{31}X_1 + b_{21}x_2$

Where, $b_{21}x_2$ means the standardized partial regression coefficient for predicting variable 1 when the effect of variable 2 is held constant.

In path analysis the beta co-efficient indicates the direct of X_1 (j=1,2,3,...p) on the dependent variable. Squaring the direct effect yields the proportion of variance on the dependent variable Y which is due each of the number of independent variable X_1 (j=1,2,3...p). After calculating the direct effect one may obtain a summary measure of the total indirect of X_1 on the dependent variable Y by subtracting from the correlation coefficient r_{yxj} the beta co-efficient b i.e.

Indirect effect X_1 on $y = C_{jy} = r_{yxj} - b_1$

For all j=1, 2, 3...p

Multiple regression analysis

Multiple regression analysis technique was used to determine the degree to which the dependent variable could be predicted with the independent variables and also to trace out the contributory influence of independent variables on dependent variables. The following prediction equation was usd for this study to determine the partial regression coefficients:

$Y = a + b_1x_1 + b_2x_3 + ,\ldots\ldots + b_nn_n$

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Where,

Y=dependent variables

a=constant term

b1…bn=partial regression coefficients, and

n=number of independent variables

Each regression coefficient (b) which appears in the above equation represents the amount of change in Y that can be associated with a given change in any one of the X's with remaining independent variable held fixed.

The multiple regression tool as also used to compute coefficient of multiple determination (R2). This gives the percentage of variation explained by the independent variables (X1, X2,…Xn) in dependent variable (Y).

The R2 can be calculated by using formula:

$$R2 = \frac{\sum biS1Y}{SYY}$$

Where ,

R2 = Coefficient of multiple determination

B1 = Partial regression coefficient of Y on X1

S1Y = ∑X1Y1, and

$$SYY = \sum Y2 - \frac{(\sum Y)2}{n}$$

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Factor analysis

Factor analysis is a method for investigating whether a number of variables of interest Y1, Y2, …. Yl, are linearly related to a smaller number of unobservable factors F1, F2, ….. Fk . The fact that the factors are not observable disqualifies regression and other methods previously examined. However, that under certain conditions the hypothesized factor model has certain implications and these implications in turn can be tested against the observations. Exactly what these conditions and implications are, and how the model can be tested, must be explained with some care.

Exploratory Factor Analysis (EFA): Used to explore the dimensionality of a measurement instrument by finding the smallest number of interpretable factors needed to explain the correlations among a set of variables – exploratory in the sense that it places no structure on the linear relationships between the observed variables and on the linear relationships between the observed variables and the factors but only specifies the number of latent variables.

• Confirmatory Factor Analysis (CFA) Used to study how well a hypothesized factor model fits a new sample from the same population or a sample from a different population – characterized by allowing restrictions on the parameters of the model

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Concepts used in factor analysis

Some important concepts used in factor analysis are explained by Kothari (1996) as follows-

Factor-A factor is an underlying dimension that accounts for several observed variables. Factor is a hypothetical construct or classification. There may be one or more factors, depending upon the nature of the study and the number of variables involved in it.

Factor loading – Factor loading are those values which explain how closely the variables are related to each one of the factor discovered. Factor loading work as key to understanding what the factor mean. It is the absolute size (rather the sign, plus or minus) of the loading that is important in the interpretation of a factor. Since the factors happen to be linier combination of data , the co-ordinates of each observation of variables is measured to obtain what are called factor loading. Such factor loading represent the correlation between the particular variable and the factor, and are usually placed in a matrix of correlation between the variables and the factor.

Applications of factor analysis

- Personality and cognition in psychology
- Child Behavior Checklist (CBCL)
- MMPI
- Attitudes in sociology, political science, etc.
- Achievement in education

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• Diagnostic criteria in mental health

The factor analysis model

The factor analysis model expresses the variation and

Co-variation in a set of observed continuous variables y (j = 1 to p)

as a function of factors η (k = 1 to m) and residuals ε (j = 1 to p).

For person i,

$yi1 = v1 + \lambda 11\ \eta i1 + \lambda 12\ \eta i2 + \ldots + \lambda 1k\ \eta ik + \ldots + \lambda 1m\ \eta im + \varepsilon i1$

...

$yij = vj + \lambda j1\ \eta i1 + \lambda j2\ \eta i2 + \ldots + \lambda jk\ \eta ik + \ldots + \lambda jm\ \eta im + \varepsilon ij$

...

$yip = vp + \lambda p1\ \eta i1 + \lambda p2\ \eta i2 + \ldots + \lambda pk\ \eta ik + \ldots + \lambda pm\ \eta im + \varepsilon ip$

Where,

vj are intercepts

λjk are factor loadings

ηik are factor values

εij are residuals with zero means and correlations of zero

with the factors

In matrix form,

$y\text{i} = v + \Lambda\ \eta\text{i} + \varepsilon\text{i}$,

where

v is the vector of intercepts vj,

Λ is the matrix of factor loadings λjk,

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Ψ is the matrix of factor variances/covariances, and

Θ is the matrix of residual variances/covariances

with the population covariance matrix of observed variables Σ,

$\Sigma = \Lambda \Psi \Lambda \square + \Theta$.

Analysis of data

The data of the present investigation with the help of the above mentioned statistical tools has been analysed taking the support of the package SPSS (Ver. 7.5).

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