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Abstract

Existing literature in social sciences, on agriculture, livestock, gender, socio-cultural dynamics, and rural demographics provides a solid background to construct a list of factors that predict and provide information on the existence of a relationship between women's participation in livestock management and production related activities and social, economic, cultural, familial, and livestock related factors. The present study has analyzed factors influencing women's level of participation in livestock management activities in Punjab province of Pakistan. Primary data was collected from three agro-climatic regions of Punjab. A multi-stage sampling technique was adopted to gather the information. The information collected from 360 farm households were processed and analyzed by using multiple regression and factor analysis. In the regression analyses, the identified main factors (in decreasing order in terms of variance explained by R^2) were respectively: *participation of family labor* (variance explained = 56.70%), *various aspects of women's status* (= 16.10%), *livestock related factors* (= 11.30%), and *economic factors* (= 10.50%). The value of the coefficient of determination (R^2) of the regression model (including all 30 factors) was 0.675. Factor analysis summarized the originally 30 variables (participatory indicators) into 11 factors, which accounted for 66.617% of the total variance explained. The results signify the need for micro-level (targeting rural families) and gender analysis in livestock farming. The findings also advocates for choosing gendered approach (with major participation of women) for a successful implementation of the agricultural development programs in the

province of Punjab. In addition, increasing women's participation in livestock management and production has positive implications for improving overall family's health, education, and income.

1. Introduction

Rural women undertake a wide range of agriculture related activities both in the field and at home but their role in rural economy has never been appreciated to its fuller extent. Livestock management is largely a woman's job. According to a few available time allocation studies, the estimated time spent by a woman on livestock related activities ranges from 3 to 5 hours per day (Hamdani, 2002). It is widely acknowledged that among all the livestock production and management, women perform the most of all (Tulachan & Karki, 2000).

In a study conducted by Hashmi, et al. (2007) in the rural areas of district T.T.Singh (Punjab), women have been found more conscious than that of men regarding animals' care. The probability of disease(s) to be found in animals was relatively lower and income generation was higher from the animals reared by women than that of managed by men. Highly significant results show positive impact of women's participation in the livestock management and thus in poverty alleviation.

Several studies has documented that women participate more in livestock related activities than that of crop production. In rural areas of Punjab, women are, in general, responsible for livestock rearing. It has been found that a rural woman in Punjab works about 15 hours a day and spends about 5.30 hours in caring of livestock. These women carry out wide range of tasks such as feeding, collecting fodder, grazing, cleaning animals and their sheds, making dung cakes (securing them properly for use as fuel), collecting manure, milking, milk processing and even marketing of animal products (like butter, butter oil or ghee etc.). Rural women have been observed to be heavily engaged in almost all activities regarding livestock production with a few exceptions. Women are an ideal choice for entrusting the task of raising livestock as an individual enterprise. Adding one or two animals in the household assets yields significant economic gains without causing hardships in the shape of physical inputs. The main challenges faced by the women folk in rural areas include low literacy level; poor health and dietary conditions; burden of multiple roles; and the use of incompatible tools/technology for crop and livestock management. Experiences of Rural Support Programs (RSPs) provide sufficient evidence that women can effectively be involved in livestock

enterprise and it will help realize their potential and improve their socio-economic status (Hamdani, 2002).

In a study conducted in northern areas of Pakistan, Afridi, *et al* (2009) have found that on an average, a rural woman is spending 5 to 6 hours daily in different livestock management activities where 68% of that time is spent on the activities of milking, farmyard manure collection, stall feeding and fodder cutting. They calculated that a woman from a household with small sized farm spends maximum time in fodder cutting (64.8 minutes) and shed cleaning (43 minutes) while managing livestock. Regarding their participation in different livestock management activities, the highest percentage (98.76%) was counted in shed cleaning followed by farmyard manure collection (87.34%), stall feeding (87.05%), and watering/hauling (85.78%).

Jehan, (2000) states that women's participation rate is very high in different sub-sectors of rural economy. In livestock sector, their contribution is more visible than in crop production. A rural woman in Punjab spends about one fifth to over a quarter of their daily working hours in livestock related activities and the family male's input outweighs that of female's in only four out of fourteen livestock production related activities.

In Pakistan a large part of women's work related to the farm, poultry and animal husbandry practices is considered as part of their routine homework and their contribution is not considered as economically productive (Riaz, 1994). It was reported (PARC, 2004) that majority of the rural females were engaged in fodder cutting, milking the animals and its allied functions. Manure collection, maintenance of animal sheds and preparing dung cakes were the special activities of rural women. Except grazing, women were involved in all animal husbandry activities from feeding, housing milking etc. However, the level of taking part diversified from one task to other. Women carried out certainly most of the caring activities of livestock. All the animal husbandry practices were considered the basic responsibility of rural women. The male took the herds to the pastures and brought them back to their sheds (Khushk and Hisbani, 2004 and Ranjha et al., 2009). In a few micro studies, the gendered division of labor in livestock production was studied in selected operations and out of total in only small number of livestock management activities male participation outnumbered that of females (Ishaq, 1995; Ijaz and Davidson, 1997; Farooq et al., 2007).

2. Literature Review on Factors Affecting Women's Participation in Livestock Management

Rural women in Punjab are taking part in almost every livestock management and production related activities. They work more than men. There are many socio-economic and cultural factors that are hindering them to utilize their full potential in this endeavor. The purpose of this section is to highlight those factors and to describe how significantly these factors are affecting women's level of participation in livestock management activities. These factors are the determinants that can increase or decrease the probability of women's participation in livestock management or in other words can affect women's participation either positively or negatively.

Age of the Respondent: Aging is associated with a progressive decrement in various components of physical work capacity, including aerobic power and capacity, muscular strength and endurance, and the tolerance of thermal stress (Shephard, 1999). It has been observed that in the rural areas of Pakistan the women after the middle age are not in the good health condition (Azid, et al 2001).

Education: Existence of a relationship has been found between the level of education and women's participation in extra- and intra-household activities by Alderman and Chishti (1991).

Marital Status: The marital status of a woman matters in determining her level of participation in the income generating activities. Social and economic status of the widowed women coupled with the family's headship status put them in a condition where they have to work hard to meet the subsistence needs of the family. It is evident from the previous many researches on poverty and women's vulnerabilities that the poor families or households with the female head are more likely to be economically vulnerable than male-headed households (Kishore and Gupta, 2009), because of having less education and availability of employment opportunities. In rural Pakistan, over the last two decades, 9 percent rural households are being headed by females and it is considered financially difficult for a woman to run a household alone (NIPS and Marco, 2008).

Health Status: Condition of health is an indicator of a person's working abilities and efficiencies. A woman with a condition of good health will be more energetic and will have comparative advantage in performing effort-intensive activities. For married women, child care and housework

are the effort intensive and tiring activities, woman with these responsibilities would have less energy available for economic activities (Becker, 1985).

In rural areas of Pakistan, women have low educational, health, and nutritional status. A girl is treated by her parents as inferior to a boy; hence, as compared to boy, she has to face discrimination in education, food, and other facilities or necessities of life (Jehan, 2000). In rural Punjab, women were suffering from nutritional deficiency both in terms of quantity and quality. Fodder cutting, poultry raising and milk processing are the activities largely done by women but in spite of spending much of their time for animal care and management their diet remained protein deficit, hence they remain malnourished (Saghir , et al. 2005a). In another study, it was found that regarding caloric intake, the most malnourished aged groups were 15-29 years and 30-44 years, while the least deficient age group was 45-59 years. The diet of an overwhelming majority of respondents (72.34%) was protein (egg, milk, yogurt, and meat) deficient (Saghir, et al. 2005b).

Family Type: Familial system, that is, living in a joint or nucleus family has its own social impact on rural women's participation in work (Azid, et al 2001). In a study conducted by (Amin, et al., 2010) data regarding the family system revealed that in Punjab, most of the respondents were living in the joint family system (70.6%).

Family Composition (Dependency Ratio): In rural areas, the families with large sizes, increase women's responsibilities as housewives and mothers so affect and limit their number of hours' allocation to economic activities (Azid, et al 2001).

In Pakistan, officially working age is from 15 to 64 years. People between these ranges of age are potentially more active and efficient regarding their working abilities. They can better contribute and participate in the economic activities to serve their families and ultimately to serve the nation. Non-working age population comprises of the individuals having their ages below 15 and above 64 years. This part of population is physically and mentally not in a condition to serve their families and the nation as efficiently and actively as can do the working-age segment of the population.

Size of Landholding: It is not cost effective for smallholders to hire paid labor for agriculture. So, the smaller the size of the landholding, the more intense, active and efficient the role of the women becomes in order to make agriculture economically affordable (Habib, 2004).

Average Annual Income of the Family: Poverty stricken families often require the contribution of women to keep the family out from a state of utter poverty. As a result, women from poorer households tend to play a greater role in livestock production than women from relatively well off families (Shafiq, 2008).

Purdah: Observing Purdah (veil) is also amongst the factors that have their own social impact on women's participation in work (Azid, et al 2001). Purdah is not just the hiding of body and face from the unknown males rather it can have many forms like, not facing, talking with, or seeing at an unknown male is also purdah.

Level of Participation in Decision Making in Family Matters: In the patriarchal family system, men are mostly involved in formal economic and social affairs and decision making processes in the community and their family. However, in Punjab province of Pakistan women have significant role in the decision making process regarding family affairs, farm and livestock management activities (Tibbo, et al. 2009).

Husband's Consultation in Decision Making in Livestock Management Related Matters: According to a study conducted by Arshad, et. al., (2010) it was found that about 56% of the respondents were in favor that their family heads should give them the right in decision making. However, about 66% of the respondents were satisfied with their existing involvement in decision making. Ranking order of the identified factors affecting the respondents' participation in decision-making process related to livestock management, from top to down were: rural women's age, male dominance, traditional belief system, misinterpretation of religious teachings, cultural norms, resistance from family members, control over resources, rural women's education, and lack of awareness about their social rights.

Herd Size: As it is evident from the work of Afridi, et al (2009) that while managing small, medium and large sized herd, women's time allocations toward livestock management activities were 2.76 hours, 4.12 hours and 3.23 hours respectively.

Cultural settings: Jehan (2000) is of the view that women's participation rate in agriculture is very high in rural areas and due to strong cultural norms they work predominantly on their own land holdings. The cultural norms in the conservative societies of the two countries (Pakistan and

Afghanistan), particularly in Afghanistan, do not allow women to move out of their home without their guardian, limiting hired agricultural jobs for women (Tibbo, et al., 2009). Women are mostly responsible for animals kept at the homestead (Bravo-Baumann, 2000).

Seeing the role and the determinants of rural women's participation in livestock management and production activities, the study intends to explore the impact of socio-economic, demographic, and geographic settings on the level of participation in three agro-climatic zones of Punjab-Pakistan.

Expressing the background of the study and a brief review of literature in the preceding sections, onward the study presents data and methodology section followed by the results and discussion. The last section concludes the whole discussion and suggest some policy measures.

3. Data and Methodology

The province of Punjab has been agro-climatically been divided into five regions. For the present study, three out of the five agro-climatic regions were selected. The present study is based on primary data collected through a structured questionnaire. The data were collected from three districts of Punjab. A multi-stage sampling technique was adopted to collect the data from livestock keeping families. At first stage, three districts were purposively selected. Secondly, from each district headquarter four villages were randomly selected. Thirdly, from each village thirty livestock keeping families were randomly selected. Hence, in total 360 farm families were consulted for the collection of data. A well-structured questionnaire was used as an instrument whereas face-to-face interviewing was applied as a technique for data collection. The data was analyzed by using statistical package for social science (SPSS®) version 20. In our study/survey, we collected information on seven different kinds of activities regarding livestock management and production in which mostly women participate. Those activities were: fodder cutting, fodder serving, serving water to the animals, collecting dung, bathing animals, milking of animals, and selling milk. Women's participation in livestock management and production related activities was calculated through generating an index.

3.1. *Categorization of Factors Affecting Women's Participation in Livestock Management Activities*

We established a list of 30 factors and put them under 7 categories (table 1). Each category of particular factors was assigned a theme or name. These categories are: various aspects of women's status, husband's socio-economic status, participation of family labor, demographic factors, livestock related factors, economic factors, and geographic factors. A short description of each of the category is given below.

Various aspects of women's status: comprising of five different aspects of women's status this category consists of 10 factors (from factor1 to factor 10). Each aspect further comprises of its constituents. Women's *socio-economic status* comprises of two elements which are: respondent woman's age and her level of education. *Health status* simply determines respondent woman's self-reported health condition. *Gender relations* are being determined by the degree of her participation in the decision making on the matters relating to livestock management, her participation in the decision making on family related matters, and the situation of domestic violence she is confronting with. Respondent woman's *mobility status* is captured by taking into consideration the practice of observance of veil (purdah), and the nature of her mobility (accompanied or unaccompanied). Two elements determining a woman's *awareness status* are: either or not she is watching television and either or not she had ever an experience of living in a city. *Husband's socio-economic status*: comprising of 3 factors/factors (from hypothesis 11 to hypothesis 13) this category taking into account the age, level of education, and occupational status of respondent woman's husband. The category of *participation of family labor* is comprised of 3 factors/factors (from factor 14 to factor 16) concerning the levels of participation of respondent's husband, her children, and her in-laws in the livestock farming activities. *Demographic factors* carry 3 elements (from factor 17 to factor 19) which are: family size, family type, and the number of children below 15 years age. *Livestock related factors*, this category (from factor 20 to factor 24) consist of 5 factors: total number of animals, type of the animals, place of keeping animals, number of problems in keeping livestock, and natural logarithm (LN) of the income earned from the animals. *Economic factors* (from factor 25 to factor 28) include the respondent's family's land tenure status, size of the own landholding, natural logarithm (LN) of the total family income, and the poverty/welfare status of the respondent's family. *Geographic factors* (from factor 29 to factor

30) comprise of 2 factors: distant location of the village from the city, and agro-climatic conditions of the area.

3.2. Data Analysis (Descriptive, Chi square, Simple/Multiple Linear Regression, and Factor Analysis)

After formulation the next step was to testify the validity of factors on statistical ground. Our dependent variable (Y) was always *women's level of participation in livestock management activities*. To confirm the significant association of the hypothesized variables (as factors) with the dependent variable, we applied chi-square test statistics. The results from chi-square test authenticated the statistical significant association of 15 factors/variables with the dependent variable (Table 4). Chi-square test just determines, statistically, the existence or non-existence of association between two variables and does not give description about the association. To find out the nature of relationship between the variables we applied regression analyses. To determine the nature of association of each X variable with the Y variable and also to determine the variability explained (R-square, adjusted R-square values) by that X variable in the Y variable, we devised 30 simple linear regression models and in each model the same Y variable (in our case, *women's level of participation in livestock management activities*) was regressed repeatedly by one of the 30 hypothesized factors/regressors (independent variables). The results of simple linear regression are shown in the table (5) which confirms the statistically significant association of 21 explanatory variables with the Y variable. For each category of the factors, to gauge the magnitude of influence of that category (measured by noting the value of R^2: the coefficient of determination) on women's level of participation, we applied a multiple linear regression analysis. So, 7 multiple linear regression models were developed (table 6). And finally to measure the impact of all 30 factors on women's participation level, the Y variable was regressed by all 29[1] regressands in a multiple linear regression model (table 7). A factor analysis was also made to compare the overall variance explained by the two statistical techniques. Factor analysis was employed to identify latent dimensions underlying indicators that measured respondent women's participation (Table 8). This statistical approach involves finding a way to condense information about a number of original variables into a smaller set of dimensions (factors) with a minimum loss of information (Hair et

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[1] one X variable—the age of respondent's husband (X_{11}) was dropped from the model due to the problem of multi-colliniarity

al., 1998). Each factor is interpreted according to its loadings, that is, the strength of the correlations between the factor and the original variables (Tabachnick and Fidell, 1996).

Creating a small set of factors can reveal "latent" patterns of relationships among the variables. In this respect, a factor can be regarded as a single (unobserved) variable that reflects the variations in a set of variables with high loadings. Principal Component Analysis (PCA) was used to extract factors using Varimax rotation to ensure that the extracted factors were independent and unrelated to each other, and to maximize the loading on each variable and minimize the loading on other factors (Bryman and Cramer, 2005).

To test the relevance of factor analysis for the data set, the Bartlett Test of Sphericity and the Kaiser–Meyer–Olkin (Kaiser, 1974) measure of sampling adequacy were applied. Kaiser–Meyer–Olkin's overall measure of sampling adequacy for our dataset (0.642) was well above the recommended threshold value of ≥ 0.5 (Kaiser, 1974), indicating that patterns of correlation in the dataset are relatively compact and that factor analysis can be validly applied. The results of a Bartlett Test of Sphericity were also highly significant ($\chi^2 = 3124.420$, df $= 435$, p < 0.000), again suggesting that factor analysis can be validly applied to the dataset, and supporting the factorability of the correlation matrix. The number of significant factors was determined by calculating the eigenvalue (variance accounted by each factor). Factors with eigenvalues exceeding 1.0 were considered significant following Kaiser's criterion.

In statistical analyses, when two or more predictors in the model are correlated and provide redundant information about the response, this situation or problem is known as multi-collinearity. Existence of high multi-collinearity increases the standard error (S.E.) of estimates of the betas. Hence, betas' reliability decreases. Ultimately, high multi-collinearity often induces confusing and misleading results. So, to detect the existence of multi-collinearity, Variance Inflation Factors (VIFs) of each predictor are calculated. If a predictor has VIF value greater than and equal to 10 then there is a problem with multi-collinearity. Multi-collinearity can be ignored if the interest is only in estimation and prediction, but if the wish is to establish association patterns between X and Y variables, then the analyst can eliminate some predictors from the model. In our case, age of the respondent's husband (X_{11}) was correlating with age of the respondent (X_1) so, we dropped X_{11} this single variable from the model, as VIF values for this variable was above 8 (giving an

abnormal trend), while the VIF values for the remaining 29 variables, except a few, were all below 2.00 as it is evident from the table 7. The variables or factors presented in the tables follow the same sequence.

4. Results and Discussion

In the table 5, models from 1 to 10 constitute the first category of factors (*various aspects of women's status*). At respectively 1% and 5% levels of significance, respondent's age and her level of education (models 1 and 2) were found negatively associated with Y variable. In the models, the variance explained (R-square value) by these variables remained 2% and 1.7% respectively. It shows that in livestock management activities, as compared to a woman of relatively older age, the level of participation of a woman of relatively younger age is high. Similarly, as compared to a woman of relatively high level of education, a woman either illiterate or with relatively less number of schooling years have more responsibility for her day-to-day activities concerning livestock management. We have also generated descriptive statistics (averages, percentages) of these factors/variables on the basis of respondents' levels of participation: low (if undertaking 4 activities), and high (where women's involvement is in more than 4 activities). Descriptive statistics (table 2, table 3) on these factors confirm our findings that in livestock farming activities as compared to a woman with low level of participation, a woman with high participation level was of relatively younger age and had low educational level. Husband's level of consultation with the respondent (wife) while making decision on the matters relating to livestock management (model 4) and respondent's participation in the decision-making on family related matters (model 5) were highly significant and had positive relationship with the Y variable. The variances explained (R-squares) by these variables/factors were respectively, 2.6% and 2.0%. Both of these factors/variables (of models 4 and 5) are also the indicators of gender relations between wife and her husband. So, the results show that the existence of good gender relationship has a positive impact on the extent of women's participation in livestock management activities. Descriptive statistics on these variables also validate this finding by showing the high percentages of the respondents taking part in decision-making (gender relation) for those women with high level of participation in livestock management activities. Respondent's observance of veil/purdah (model 7) was highly significantly (at 1 % level) associated with her lower level of participation in livestock management activities and was explaining 3.5% variability in the model. Veil is a kind

of seclusion which limits the mobility and working ability of a woman. Generally, women cannot go alone at distant places outside home and are accompanied mostly by any of her close male relatives (like son, husband, brother, father) or by her female relatives. A woman's unaccompanied mobility means more trust by the family members on her and by this way, she can have more sense of freedom and sense of autonomous mobility, in addition, it can make her more confident even to access the markets to sale the livestock products. It is evident from our results (model 8) that a woman's unaccompanied mobility is significantly relating to her higher level of participation in livestock management activities. The variance explained (R-square) by this factor/variable in the model was 1.7%. More aware a rural woman is about the modern ways of living and decent life style, lesser will be her level of participation in livestock management activities. Results of model 10 present the same nature of relationship between respondent women's level of participation in livestock management activities and her (awareness) experience of living in a city. Urban life style has an impact in terms of modernizing a person's ideas and thoughts and increases a person's awareness and knowledge. So, a woman having an experience of living in a city has more probability to deny her heavy indulgence in the livestock management related activities. The variability explained (R-square) by this variable was 1.5%. But the variance explained by the factors of this category remained 16.10% (see the value of R^2 for model 1 in table 5).

Simple linear regression models from 11 to 13 consider the factors of our second category (*husband's socio-economic status*). The variance explained by this category was only 3.70%. The age of respondent's husband (model 11) was negatively associated with her degree of involvement in livestock farming activities. Comparative (descriptive) statistics also show that the average age of the husband for the women with high level of participation was lower than that of women with low level of participation. It may imply towards that in the participation of livestock farming activities, as compare to the husbands of younger ages, relatively older aged husbands have a more facilitative or burden-sharing attitude towards their wives. And so, a helping hand from her husband reduces the extent of her engagement in livestock raising activities. The variance explained (R-square) by this variable was only 1.3%. The negative sign of the coefficient (beta, in model 13) shows that the primary occupation of the respondent's husband as "non-farmer" increases the burden of respondent (his wife) in terms of more number of livestock management activities undertaken by her. Primary occupation of the respondent's husband as "non-farmer"—

this category comprises of the husband's occupation/employment as either engaged in the government/private job, running own business, daily wage earner (laborer), or as a retired pensioner. In the rural context of Punjab, crop farming and animal keeping are generally complementary activities. Almost every rural family, engaged in crop farming has been rearing livestock as well to supplement its farm income. So, going to the agricultural farms/fields, cutting or collecting fodder, and carrying fodder to the home to serve as feed to the animals, etc. are usually the routine matters a farmer performs everyday as allied activities of crop farming. Contrary to this, if a husband is a non-farmer but keeps animal, than a large burden concerning the upkeep or management of animals is on the shoulders of her wife. The variance explained (R-square) by this factor was1.4%.

The number of activities undertaken (levels of participation) by the respondent's husband (model 14), her children (model 15), and her in-laws (model 16) individually determine respondent's level of partaking in livestock raising activities. The variables in these three models (from 14 to 16) are presenting the factors of the third category (*participation of family labor*). Determining the maximum variability in the Y variable ($R^2 = 0.567$), this category is carrying the most influential group of factors. The negative signs of the betas in these three models depict the existence of inverse relationship with the dependent variable. It means that our respondent woman's level of participation will be lessening if the available labor/helping hand from her family is increased. The variances explained by these variables in the models were respectively, 20.6%, 16.2%, and 3.7%. Husband's level of participation in livestock management activities was the most (the largest in terms of magnitude) determining factor for settling/deciding the extent of women's involvement in livestock management activities. The role of respondent's children, as a factor, comes second in fixing the degree of women's engagement in animals' up keeping related activities. Respondent's in-laws though relatively lesser but have significant role in deciding her responsibilities in raising animals.

Amongst the demographic factors, respondent's family size (model 17) and (family's non-working age population) number of children below 15 years age (model 19) were positively associated with the dependent variable and the variances explained by the two variables were respectively, 1.3% and 1.2%. The results of these two models can be interpreted in terms of poverty. Women respondents with high level of participation in livestock management activities, as compared to

those with low level of participation, had relatively poorer base in terms of their agricultural land, livestock (inventory), income, and human (education, employment, available hired labor, etc.) resources. The descriptive statistics for both categories (with their levels of participation as: low, and high) of the respondent participants on the comparison of above said resources confirm the validity of our statement. Family members in poor families are generally large in number and in poor families, usually the dependency ratios either for children or for old aged persons are also higher than the non-poor families. So (in the models 17 and 19), the statistically significant (at 5 % level) and positive signs of the coefficients can be better justified, interpreted, and understood in terms of the welfare/poverty status of the rural families. In short, in resource poor families, along with the responsibilities of housekeeping, looking after their non-working aged children, and others, women have to heavily engage in livestock management related activities to reap the benefits from animals for their large sized families. Hence, rural women are doing their best at the part of their efforts, energies, time, and labor (even health) to enhance the productivity and profitability of the limited resources available to them for the welfare of their families. Explaining only 2.20% variability in the Y variable, the demographic factors do not seem to have considerable influence on women's level of participation in livestock management related activities.

Models from 20 to 24 are carrying the variables which constitute the fifth category of factors (*livestock related factors*). In terms of determining the large percentage of variability in the Y variable, this category is ranked third. The variance explained by the factors of this category was 11.30%. Woman's level of participation decreases as the number of animals (herd size) kept by her family increases (model 20). The similar trend can be seen in the model 24 where woman's level of participation is negatively associated with the income (taken in the natural log form) earned from livestock. In the rural milieu of Punjab, keeping and managing large sized herd is affordable and feasible only by the landlord and economically well of farm families. Managing large number of animals broadens the scale of animal farming more for the commercial purposes, though the benefits are also enjoyed by the families domestically. So, animal farming at large scale and where in place of a source of supplementing familial income for subsistence, this activity has more a business objective, women's less participation in this enterprise in those well off families has valid reasons that: more commercial nature of the livestock farming, due to more economic interests, makes it more attractive for the males to participate more in livestock management
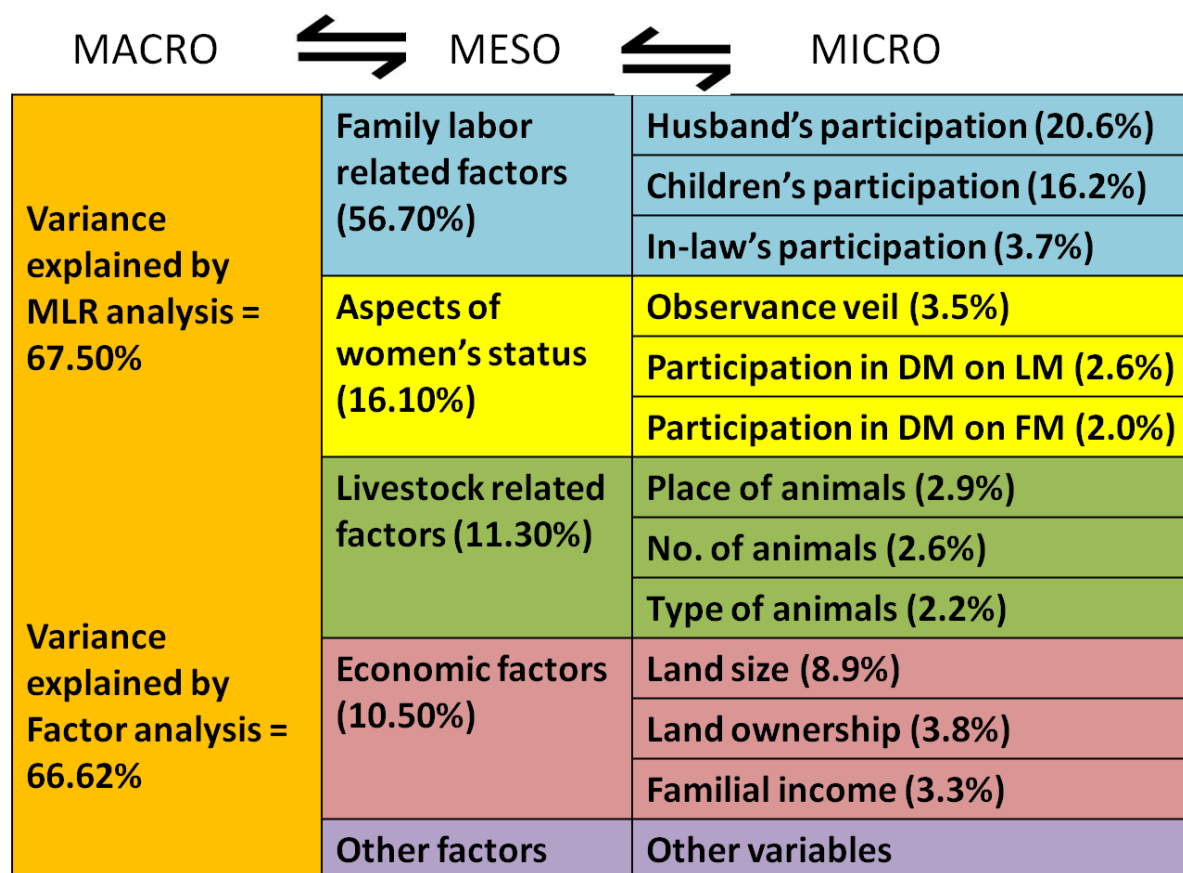
related activities. In addition, the economic interests let them afford to hire labor (technical, non-technical), seek the modern ways of livestock farming, know market trends, and adopting the methods to enhance the profitability of their livestock farming enterprise. Income earned from livestock by the well off farm families is much more than that of earned by the small farmers. It is because, as compared to the small farmers, the productivity of livestock resources managed by the large farmers is much more and per unit output is also high. Women's participation remain low and mostly in less laborious activities, like milking, milk selling, etc. type of animals or herd type (model 21) is also a statistically significant determinant of women's level of participation in livestock management activities. As compared to managing small ruminants, upkeep and management of large ruminants require more efforts and energies, so women's level of participation increases on increasing the number of large ruminants in the herd. It is evident from the result that the place where the animals are kept (model 22) matters in determining the extent of women's partaking in the activities concerning the management of animals. In the families where the animals are kept at homes, women are culturally more comfortable to participate in a wide range of activities relating to livestock management. Cultural norm of purdah allows women work mostly within the premises of four walls of their homes. Comparative descriptive statistics show that women undertaking relatively wide range of livestock management activities were mostly keeping animals at their homes in place of keeping at *havelies* or *deras* (farm-houses). The variances explained by the X variables in the models 20, 21, 22, and 24 were respectively, 2.6%, 2.2%, 2.9%, and 2.7%.

Models from 25 to 28 represent the sixth category of factors (*Economic factors*). The value of R-square calculated to determine the variability in Y variable due to economic factors was 0.105. It is evident from the results that land tenure status of the respondent's family (model 25), size of own landholding (model 26), and total income (taken in natural log form) of the respondent's family (model 27) are negatively associated with the scale of women's participation in livestock management activities. It means that the families, which are landless or have small pieces of agricultural land, and their total familial income is low, are resource poor families. Those resource poor families were heavily relying on livestock as one of the sources of their familial income. Women were greatly participating in livestock management activities and putting their best to get

the maximum benefits from livestock for their families' welfare. The variances explained by these factors were respectively, 3.8%, 8.9%, and 3.3%.

The last category of factors (*geographic factors*) comprising the variables/factors: distant location of the villages from the city, and agro-climatic conditions of the areas, did not show statistically significant effect in determining the magnitude of women's involvement in livestock management activities.

MACRO	MESO	MICRO
Variance explained by MLR analysis = 67.50% **Variance explained by Factor analysis = 66.62%**	**Family labor related factors (56.70%)**	**Husband's participation (20.6%)**
		Children's participation (16.2%)
		In-law's participation (3.7%)
	Aspects of women's status (16.10%)	**Observance veil (3.5%)**
		Participation in DM on LM (2.6%)
		Participation in DM on FM (2.0%)
	Livestock related factors (11.30%)	**Place of animals (2.9%)**
		No. of animals (2.6%)
		Type of animals (2.2%)
	Economic factors (10.50%)	**Land size (8.9%)**
		Land ownership (3.8%)
		Familial income (3.3%)
	Other factors	**Other variables**

Figure: Factors affecting women's participation in livestock management activities: the levels of association

In the figure, variance explained by all variables (macro-level analysis), categories of variables (meso-level analyses), and by individual variables (micro-level analyses) is given. Multiple linear regression analysis (table 7) showed the statistically significant association of 13 factors with women's level of participation in livestock management activities. Amongst the factors of first category (*various aspects of women's status*), respondent's age, her level of education,

participation in the decision making on livestock related matters, and her practice of observing veil were showing their significance. All the three factors of the third category (*participation of family labor*): levels of participation of respondent's husband, children, and her in-laws in livestock management activities were very significantly related in explaining the level of women's engagement in livestock management activities. Family size was the only significantly relating *demographic factor*. Amongst the *livestock related factors*, the type of animal and place of keeping animals demonstrated statistically significant relationship with the Y variable. Number of acreage of land, total income, and the welfare/poverty status of respondent's family were amongst the *economic factors* which were significantly relating with respondent women's level of participation in livestock management activities. The value of the coefficient of determination (R^2) of the model was 0.675, which means that 67.50% variability in the explained (Y) variable is due to the significantly associated X variables of the model.
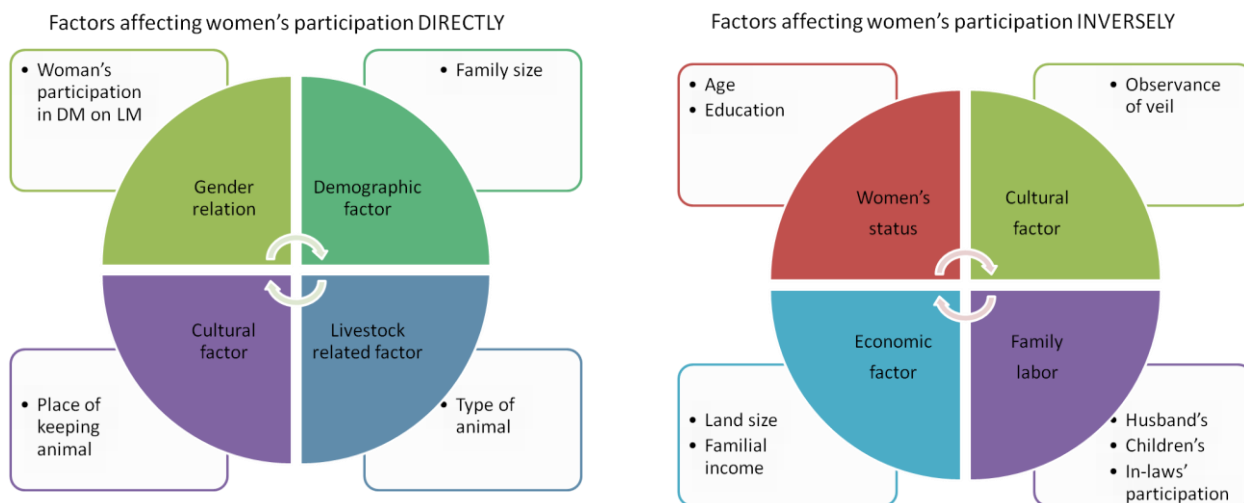
Figure: Factors affecting women's participation in livestock management activities: the natures of association

Factor analysis follows its own procedure or criteria to summarize the variables/indicators into the factors. In our case, the factor analysis summed up originally 30 variables in 11 factors (table 8). Here, we do not intend to go deep in the details of all factors, but are interested in factor 1, factor 5, factor 6, and factor 9 only. The reason of our interest is the existence of resemblance between these factors and the categories of factors we made. Explaining 10.31% variation, factor 1 is comprised of the variables more or less relating to the condition of economic resources in the

respondent's family. The constituents of factor 5 are related to the respondent's participation in decision making on livestock and family related matters. This factor explained 6.05% variation. Explaining 5.39% variation, factor 6 is carrying two demographic variables. Factor 9 is about the mobility status of respondent women and explains 4.36% variance. More interestingly, the total variance explained by all the variables/factors in factor analysis was 66.617% which is comparable with that of explained by our multiple linear regression model with its R^2 value 0.675.

5. Conclusions

Going through the parts to the whole in search of how an explanatory factor—affecting either individually and/or collectively in a group of related or non-related factors—explains a particular variable, we made simple and multiple linear regression analyses. Descriptive analyses were made to present the characteristics of the variables. Chi square analysis confirmed the factors about the association between variables. The purpose of factor analysis was to compare the variance explained with the R-square given by multiple linear regression. The findings obtained in this study indicate that, the factors associated to participation of family labor, various aspects of women's status, livestock related matters, and economic resources are the most important determinants of rural women's participation in livestock management activities in Punjab (Pakistan).

Availability of family labor, that is, the levels of participation of respondent's husband, children, and her in-laws in livestock management activities have substantial role in determining the level of women's engagement in livestock management activities. Socio economic status of women (respondent's age, her level of education), gender relations (her level of participation in the decision making on livestock related matters), and cultural norms (practice of observing veil) have confirmed their role as well in determining the extent of women's involvement in livestock management activities in rural Punjab. Finding the scope of women's workability in managing livestock kept at homes and out of the homes, has also the cultural interpretations. Respondent's family size, type of the herd, land ownership status of respondent's family in terms of number of acreage of farmland, total familial income, and the welfare/poverty status of respondent's family are also amongst the determinants of women's partaking in the activities relating to livestock management and production.

The availability of land resources and livestock management related infrastructure can facilitate the rural families in keeping livestock. Majority of the respondents belonged to the families engaged in crop farming, hence livestock keeping provide them an opportunity to diversify their livelihoods, that is, rather than relying solely on crop farming, livestock farming assure for them at least the food security and a source of continuous income in case of crop failure due to its exposure to the natural calamities or due to any other reason(s). Women's participation in livestock management can be enhanced if the sphere of their participation in the decision making process can be broadened. Prevailing traditions and cultural settings towards assigning roles or making division of labor between husband and wife in agricultural activities have strong implications for determining women's participation in livestock management activities. As in our study, it was seen that in 47%, 24%, 21%, and 8% cases (families) husband's participation in managing livestock was respectively, none, low, medium, and high. So, women remained to shoulder for the bulk of the rest of the activities.

These results have several policy implications. First, women are the main actor or contributor in livestock management and production related activities. In poor rural families, they sell milk or/and milk products to earn money, even sacrifice their part of food from milk for their family members, especially for their children, and continue undertaking activities for production and management of livestock even in a serious ailment. So, their heavy indulgence and the importance of their participation in this undertaking must be recognized and acknowledged not only in the society at local levels but in national accounts as well.

Second, all those cultural, social, and economic factors that are responsible for keeping women underdeveloped, unproductive, and curbing their progress needs to be curbed and condemned by devising and implementing policies, bringing behavioral changes in the minds of people, especially males, creating equal opportunities of gaining access to education, health, and employment to build, incorporate, and streamline the half of country's human resource into the national development process.

Third, government and other institutions must organize women-focused programs or projects to train them and to build their capacities in better and more profitable livestock farming, so that women's contribution in family income and ultimately in the national income can be raised.

Women must also be focused because in the words of IFAD (1991): women are prime movers, rather than welfare recipients, in the development process and vital agents, rather than passive bystanders, in the process of change.

Table 1 : Categories, names, labels, codes/scores of the variables/factors

Category of factors	No.	Names of variable/factor	Label	Code/Scale
1st: Various aspects of women's status	1	Respondent's age (in years)	X_1	18-65
	2	Respondent's level of education	X_2	0-14
	3	Health Status (Very good=3, Good=2, Average=1, Poor=0)	X_3	0-3
	4	Level of participation in the decision making on the matters relating to livestock management (Always=3, Often=2, Sometime=1, Never=0)	X_4	0-3
	5	Participation in the decision making on family matters (Yes=1, No=0)	X_5	0-1
	6	Quarrel with Husband (Yes=1, No=0)	X_6	0-1
	7	Observing veil/Purdah (Yes=1, No=0)	X_7	0-1
	8	Mobility (unaccompanied=1, accompanied=0)	X_8	0-1
	9	Watching television (Yes=1, No=0)	X_9	0-1
	10	Having experience of living in a city (Yes=1, No=0)	X_{10}	0-1
2nd: Husband's socio-economic status	11	Husband's age	X_{11}	20-80
	12	Husband's level of education	X_{12}	0-16
	13	Husband's primary occupation (Farmer=1, Non farmer=0)	X_{13}	0-1
3rd: Participation of family labor	14	Husband's level of participation in livestock management activities	X_{14}	0-6
	15	Children's level of participation in livestock management activities	X_{15}	0-6
	16	In-laws' level of participation in livestock management activities	X_{16}	0-6
4th: Demographic factors	17	Family size	X_{17}	1-11
	18	Family system (Nuclear=1, Non-nuclear=0)	X_{18}	0-1
	19	No. of children below 15 years of age	X_{19}	0-6
5th: Livestock related factors	20	Total no. of animals	X_{20}	1-48
	21	Type of animal (small ruminants = 1, large ruminants = 2, both = 3)	X_{21}	1-3
	22	Place of keeping animals (house=2, haveli=1, farmhouse/dera=0)	X_{22}	0-2
	23	No. of problems in keeping livestock	X_{23}	0-3
	24	Income from animals (in natural log form)	X_{24}	7.60-13.12
6th: Economic factors	25	Land tenure status (landless = 0, tenant/share cropper = 1, own land = 2)	X_{25}	0-2
	26	Size of own landholding (in acres)	X_{26}	0-63
	27	Total familial income (in natural log form)	X_{27}	9.55-14.73
	28	Family's welfare/poverty status (poor=1, non-poor=0)	X_{28}	0-1
7th: Geographic factors	29	Distant location of the village from city (near=0, far=1)	X_{29}	0-1
	30	Agro climatic zones (BNR=1, CKL=2, FSD=3)	X_{30}	1-3
Scale for the dependent variable: respondent women's level of participation in livestock management activities (Y) = 1-7				

Table 2 : Descriptive statistics (averages and percentages) on the variables included in the analyses (Part 1)

Label	Variables	Low level of participation (n = 181)	High level of participation (n = 179)	Overall descriptive Statistics (N = 360)
X_1	Respondent's age (average)	41.84	39.90	40.88
X_2	Respondent's level of education (average)	3.73	2.89	3.32
X_3	Health Status (Very good=3, Good=2, Average=1, Poor=0) (in percentages)			
	Poor	14.4	18.4	16.4
	Average	46.4	45.8	46.1
	Good	27.6	24.6	26.1
	Very good	11.6	11.2	11.4
X_4	Husband Consult (Always=3, Often=2, Sometime=1, Never=0) (in percentages)			
	Never	14.9	10.6	12.8
	Sometime	25.4	23.5	24.4
	Often	30.4	20.1	25.3
	Always	29.3	45.8	37.5
X_5	Participation in Decision on Family Matters (Yes=1, No=0) (in percentages)			
	No	43.6	31.3	37.5
	Yes	56.4	68.7	62.5
X_6	Quarrel with Husband (Yes=1, No=0) (in percentages)			
	No	74.0	80.4	77.2
	Yes	26.0	19.6	22.8
X_7	Observing Purdah (Yes=1, No=0) (in percentages)			
	No	73.5	88.8	81.1
	Yes	26.5	11.2	18.9
X_8	Mobility (unaccompanied=1, accompanied=0) (in percentages)			
	Accompanied	84.5	73.7	79.2
	Unaccompanied	15.5	26.3	20.8
X_9	Watching television(Yes=1, No=0) (in percentages)			
	No	16.6	22.3	19.4
	Yes	83.4	77.7	80.6
X_{10}	Having experience of living in city (Yes=1, No=0) (in percentages)			
	No	81.2	89.4	85.3
	Yes	18.8	10.6	14.7
X_{11}	Husband's age (average)	46.22	44.89	45.56
$X1_2$	Husband's level of education (average)	5.82	5.35	5.59
X_{13}	Husband's Occupation (Farmer=1, Non farmer=0) (in percentages)			
	Non farmer	32.6	42.5	37.5
	Farmer	67.4	57.5	62.5
X_{14}	Husband's level of participation in livestock management activities (average)	2.29	0.65	1.47
Scale for the dependent variable: respondent women's level of participation in livestock management activities (Y) = 1-7				

Table 3 : Descriptive statistics (averages and percentages) on the variables included in the analyses (Part 2)

Label	Variables	Low level of participation (n = 181)	High level of participation (n = 179)	Overall descriptive Statistics (N = 360)
X_{15}	Children's level of participation in livestock management activities (average)	1.15	0.12	0.64
X_{16}	In-laws' level of participation in livestock management activities (average)	0.24	0.01	0.13
X_{17}	Family size (average)	5.09	5.64	5.37
X_{18}	Family System (Nuclear=1, Non-nuclear=0) (in percentages)			
	Non-nuclear	51.9	56.4	54.2
	Nuclear	48.1	43.6	45.8
X_{19}	No. of children below 15 years of age (average)	1.27	1.65	1.46
X_{20}	Total no. of animals (average)	6.60	4.92	5.76
X_{21}	Type of Animal (Small Ruminants = 1, Large Ruminants = 2, Both = 3) (in percentages)			
	Small ruminants	5.0	4.5	4.7
	Large ruminants	29.8	20.1	25.0
	Both	65.2	75.4	70.3
X_{22}	Place of keeping animals (House=2, Haveli=1, Dera/farmhouse=0) (in percentages)			
	Dera/farmhouse	27.6	15.1	21.4
	Haveli	22.1	22.3	22.2
	Home	50.3	62.6	56.4
X_{23}	No. of Problems in Keeping Livestock (in percentages)			
	No any	14.4	13.4	13.9
	One	54.7	55.9	55.3
	Two	26.0	24.0	25.0
	Three	5.0	6.7	5.8
X_{24}	Average annual income from livestock (average)	60171.27	44458.10	52358.33
X_{25}	Land Tenure Status (Landless = 0, Tenant/At Part = 1, Own Land = 2) (in percentages)			
	Landless	4.4	15.1	9.7
	Tenant/sharecropper	8.3	12.8	10.6
	land owner	87.3	72.1	79.7
X_{26}	Size of own landholding in acres (average)	7.48	2.96	5.23
X_{27}	Average annual income of the family (average)	272635.36	193603.35	233338.89
X_{28}	Poverty (Poor=1, Non poor=0) (in percentages)			
	Non poor	83.4	74.9	79.2
	Poor	16.6	25.1	20.8
X_{29}	Distance From City (Near=0, Far=1) (in percentages)			
	Near	49.2	50.8	50.0
	Far	50.8	49.2	50.0
X_{30}	Agro climatic zones (BNR=1, CKL=2, FSD=3) (in percentages)			
	Cotton-wheat (BNR)	29.8	36.9	33.3
	Rain-fed (CKL)	43.1	23.5	33.3

	Mix-crop (FSD)	27.1	39.7	33.3
Y	Respondent's level of participation in livestock management activities (average)	2.56	6.25	4.40

Table 4 : Chi square analysis: association between X and Y variables

Variables		Pearson Chi-Square	
Label	Names of variable/factor	Value	df
X_1	Respondent's age	271.212*	240
X_2	Respondent's level of education	47.165**	30
X_3	Health Status	24.970^{NS}	18
X_4	Level of participation in the decision making on the matters relating to livestock management	22.143^{NS}	18
X_5	Participation in the decision making on family matters	7.927^{NS}	6
X_6	Quarrel with Husband	6.799^{NS}	6
X_7	Observing veil/Purdah	26.645***	6
X_8	Mobility	10.086^{NS}	6
X_9	Watching television	3.704^{NS}	6
X_{10}	Having experience of living in a city	15.999**	6
X_{11}	Husband's age	262.771*	228
X_{12}	Husband's level of education	37.959^{NS}	36
X_{13}	Husband's primary occupation	9.845^{NS}	6
X_{14}	Husband's level of participation in livestock management activities	469.613***	36
X_{15}	Children's level of participation in livestock management activities	148.081***	42
X_{16}	In-laws' level of participation in livestock management activities	58.783**	36
X_{17}	Family size	67.383^{NS}	60
X_{18}	Family system	3.015^{NS}	6
X_{19}	No. of children below 15 years of age	31.372^{NS}	36
X_{20}	Total no. of animals	160.080**	132
X_{21}	Type of animal	24.280**	12
X_{22}	Place of keeping animals	23.645**	12
X_{23}	No. of problems in keeping livestock	19.377^{NS}	18
X_{24}	Income from animals	252.707***	186
X_{25}	Land tenure status	31.148***	12
X_{26}	Size of own landholding	458.673***	384
X_{27}	Total familial income	444.768^{NS}	450
X_{28}	Family's welfare/poverty status	8.025^{NS}	6
X_{29}	Distant location of the village from city	7.437^{NS}	6
X_{30}	Agro climatic zones	75.624***	12
Y	Women's level of participation in livestock management activities		

Table 5 : Factors affecting women's level of participation in livestock management activities:

Model	Label	Variable	(Constant)	Std. Error	Standardized Coefficients Beta	R Square	% Variance Explained
		Table : Factors affecting women's level of participation in livestock management activities: Analyses from simple linear regression models					
1	X_1	Respondent's age	5.570	0.01	-0.140***	0.020	2.0
2	X_2	Respondent's level of education	4.609	0.03	-0.130**	0.017	1.7
3	X_3	Health Status	4.409	0.13	-0.004^{NS}	0.000	
4	X_4	Participation in decision on livestock related matters	3.805	0.10	0.160***	0.026	2.6
5	X_5	Participation in decision on family matters	4.015	0.23	0.142***	0.020	2.0
6	X_6	Quarrel with husband	4.478	0.26	-0.072^{NS}	0.005	
7	X_7	Observing purdah	4.586	0.28	-0.187***	0.035	3.5
8	X_8	Mobility	4.256	0.27	0.132**	0.017	1.7
9	X_9	Watching television	4.643	0.28	-0.058^{NS}	0.003	
10	X_{10}	Having experience of living in city	4.505	0.31	-0.124**	0.015	1.5
11	X_{11}	Husband's age	5.346	0.01	-0.112**	0.013	1.3
12	X_{12}	Husband's level of education	4.585	0.02	-0.081^{NS}	0.007	
13	X_{13}	Husband's primary occupation	4.711	0.23	-0.117**	0.014	1.4
14	X_{14}	Husband's level of participation	5.199	0.06	-0.454***	0.206	20.6
15	X_{15}	Children's level of participation	4.754	0.07	-0.403***	0.162	16.2
16	X_{16}	In-laws' level of participation	4.469	0.15	-0.193***	0.037	3.7
17	X_{17}	Family size	3.672	0.06	0.113**	0.013	1.3
18	X_{18}	Family system	4.513	0.22	-0.060^{NS}	0.004	
19	X_{19}	No. of children below 15 years of age	4.176	0.07	0.111**	0.012	1.2
20	X_{20}	Total no. of animals	4.770	0.02	-0.161***	0.026	2.6
21	X_{21}	Type of animal	2.940	0.19	0.149***	0.022	2.2
22	X_{22}	Place of keeping animals	3.802	0.13	0.171***	0.029	2.9
23	X_{23}	No. of problems in keeping livestock	4.419	0.15	-0.006^{NS}	0.000	
24	X_{24}	Income from animals	7.983	0.11	-0.164***	0.027	2.7
25	X_{25}	Land tenure status	5.484	0.17	-0.195***	0.038	3.8
26	X_{26}	Size of own landholding	4.809	0.01	-0.299***	0.089	8.9
27	X_{27}	Total familial income	10.540	0.14	-0.183***	0.033	3.3
28	X_{28}	Family's welfare/poverty status	4.305	0.27	0.086^{NS}	0.007	
29	X_{29}	Distant location of village from city	4.333	0.22	0.031^{NS}	0.001	
30	X_{30}	Agro climatic zone	4.306	0.13	0.018^{NS}	0.000	

Table 6 : Multiple linear regression models determining the variances explained (R-square values) by each category of factors

No.	Multiple linear regression model	F-value (df)	R-square value	Adjusted R-square value	% of variance explained
Model 1	$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + e$ *Where* *X_1 to X_{10} = regressors relating to various aspects of women's status* *β_1 to β_{10} = coefficients of the regressors* *e = error term*	6.686*** (10)	0.161	0.137	16.10
Model 2	$Y = \beta_0 + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + e$ *Where* *X_{11} to X_{13} = regressors relating to husband's socio-economic status* *β_{11} to β_{13} = coefficients of the regressors* *e = error term*	4.357*** (3)	0.037	0.028	3.70
Model 3	$Y = \beta_0 + \beta_{14} X_{14} + \beta_{15} X_{15} + \beta_{16} X_{16} + e$ *Where* *X_{14} to X_{16} = regressors relating to participants of family labor* *β_{14} to β_{16} = coefficients of the regressors* *e = error term*	155.653*** (3)	0.567	0.564	56.70
Model 4	$Y = \beta_0 + \beta_{17} X_{17} + \beta_{18} X_{18} + \beta_{19} X_{19} + e$ *Where* *X_{17} to X_{19} = regressors relating to demographic factors* *β_{17} to β_{19} = coefficients of the regressors* *e = error term*	2.641** (3)	0.022	0.014	2.20
Model 5	$Y = \beta_0 + \beta_{20} X_{20} + \beta_{21} X_{21} + \beta_{22} X_{22} + \beta_{23} X_{23} + \beta_{24} X_{24} + e$ *Where* *X_{20} to X_{24} = regressors relating to livestock related factors* *β_{20} to β_{24} = coefficients of the regressors* *e = error term*	8.483*** (5)	0.113	0.099	11.30
Model 6	$Y = \beta_0 + \beta_{25} X_{25} + \beta_{26} X_{26} + \beta_{27} X_{27} + \beta_{28} X_{28} + e$ *Where* *X_{25} to X_{28} = regressors relating to economic factors* *β_{25} to β_{28} = coefficients of the regressors* *e = error term*	10.419*** (4)	0.105	0.095	10.50
Model 7	$Y = \beta_0 + \beta_{29} X_{29} + \beta_{30} X_{30} + e$ *Where* *X_{29} to X_{30} = regressors relating to geographic factors* *β_{29} to β_{30} = coefficients of the regressors* *e = error term*	0.226[NS] (2)	0.001	-0.004	0.10
Y (regressand) = women's level of participation in livestock management activities					

Table 7 : Factors affecting women's level of participation—A Multiple linear regression analysis

Independent variables (Xs)		Std. Error	Standardized Coefficients (Beta)	t-values	Colliniarity Statistics (VIF-values)
Constant (α) = 10.545		1.759		5.996	
X_1	Respondent's age	0.010	-0.155***	-3.062	2.593
X_2	Respondent's level of education	0.022	-0.112**	-2.487	2.064
X_3	Health Status	0.080	-0.009^{NS}	-0.265	1.164
X_4	Participation in decision on livestock related matters	0.076	0.082**	2.126	1.526
X_5	Participation in decision on family matters	0.157	0.031^{NS}	0.860	1.348
X_6	Quarrel with husband	0.165	-0.002^{NS}	-0.057	1.126
X_7	Observing purdah	0.188	-0.074**	-2.093	1.272
X_8	Mobility	0.175	-0.013^{NS}	-0.368	1.182
X_9	Watching television	0.179	0.017^{NS}	0.498	1.178
X_{10}	Having experience of living in city	0.218	0.001^{NS}	0.018	1.395
X_{11}†	Husband's age	-	-	-	-
X_{12}	Husband's level of education	0.019	-0.033^{NS}	-0.777	1.801
X_{13}	Husband's primary occupation	0.159	0.052^{NS}	1.412	1.389
X_{14}	Husband's level of participation	0.046	-0.568***	-14.699	1.516
X_{15}	Children's level of participation	0.052	-0.544***	-14.452	1.441
X_{16}	In-laws' level of participation	0.099	-0.292***	-8.593	1.173
X_{17}	Family size	0.057	0.153***	3.225	2.272
X_{18}	Family system	0.151	0.032^{NS}	0.888	1.316
X_{19}	No. of children below 15 years of age	0.064	-0.035^{NS}	-0.752	2.234
X_{20}	Total no. of animals	0.015	-0.023^{NS}	-0.607	1.475
X_{21}	Type of animal	0.130	0.085**	2.402	1.269
X_{22}	Place of keeping animals	0.095	0.103***	2.809	1.378
X_{23}	No. of problems in keeping livestock	0.104	-0.032^{NS}	-0.856	1.434
X_{24}	Income from animals	0.096	0.008^{NS}	0.189	2.031
X_{25}	Land tenure status	0.134	-0.017^{NS}	-0.409	1.689
X_{26}	Size of own landholding	0.011	-0.069*	-1.695	1.671
X_{27}	Total familial income	0.164	-0.149**	-2.530	3.514
X_{28}	Family's welfare/poverty status	0.242	-0.152***	-3.218	2.258
X_{29}	Distant location of village from city	0.160	-0.060^{NS}	-1.556	1.493
X_{30}	Agro climatic zone	0.106	-0.037^{NS}	-0.888	1.758
R-square value	0.675 (variance explained = 67.50%)				
Adj. R-square value	0.647				
F-value (df)	23.643*** (29)				
†Husband's age (X_{11})—this variable was dropped due to high colliniarity and VIF value above 8. Dependent Variable (Y): Respondent women's level of participation in livestock management activities. *significance at 10% level, **significance at 5% level, and ***significance at 1% level					

Table 8 : Factor Analysis of indicators of Women's Participation in Livestock Management Activities

Factors	Indicators	Factors loadings	Commun-alities	Initial Eigen values	Variance explained† %	Variance explained‡ %
Factor 1	Income from animals	0.762	0.640	3.720	12.399	10.313
	Total familial income	0.758	0.764			
	Husband's Occupation	0.610	0.515			
	Family's welfare/Poverty status	-0.605	0.645			
	Place of keeping animals	-0.539	0.523			
	Agro climatic zones	0.462	0.666			
Factor 2	Respondent's age	0.921	0.906	3.186	10.618	10.062
	Husband's Age	0.895	0.868			
	Children's level of participation	0.543	0.616			
	Respondent's level of education	-0.508	0.689			
Factor 3	Distant location of village from city	0.671	0.680	2.176	7.252	6.406
	No. of Problems in Keeping Livestock	0.650	0.553			
	Husband's level of education	-0.567	0.706			
	Total no. of animals	0.423	0.576			
Factor 4	Having experience of living in city	0.797	0.674	1.816	6.053	6.187
	Size of own landholding	0.565	0.569			
Factor 5	Participation in decision on family matters	0.779	0.697	1.711	5.705	6.051
	Participation in decision on livestock related matters	0.718	0.596			
Factor 6	Family Size	0.855	0.853	1.645	5.483	5.390
	No. of children below 15 years of age	0.671	0.817			
Factor 7	Family System	0.744	0.643	1.384	4.614	5.281
	Type of animal	-0.531	0.665			
	Husband's level of participation	0.445	0.676			
Factor 8	Watching television	0.752	0.616	1.200	3.999	4.411
	Land tenure status	0.430	0.611			
Factor 9	Mobility	-0.839	0.755	1.079	3.596	4.367
	Observing Purdah	0.427	0.526			
Factor 10	In-laws' level of participation	-0.798	0.710	1.068	3.560	4.124
	Health status	0.380	0.560			
Factor 11	Quarrel with husband	0.741	0.669	1.001	3.337	4.026
Total variance explained (in %)				19.986	66.617	66.617

† For Extraction Sums of Squared Loadings ‡ For Rotation Sums of Squared Loadings
Extraction Method: Principal Component Analysis (PCA). Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 12 iterations. Factor loading with the values larger than 0.40 in absolute terms are given in the table. (N = 360)

Table 9 : KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.642
Bartlett's Test of Sphericity	Approx. Chi-Square	3124.420
	df	435
	Sig.	0.000

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