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Understanding the Nutritional Status of Farming Community in Rural Areas of India: An Empirical Interpretation with Policy Implication from Socio-Economic and Gender Perspective

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Authors' contributions

This work was carried out in collaboration among all authors. Author SG collected data, performed the statistical analysis, managed the literature searches and wrote the first draft of the manuscript. Author MH helped in statistical analysis. Authors KM and SS helped in preparation of manuscript. Author SKA designed the study, managed the interpretation of the analyses and supervised the work. All authors read and approved the final manuscript.

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ABSTRACT

Aims: In this empirical study an attempt is made to examine the relative importance of some socio-economic and demographic variables that affect the nutrition of farming community. This empirical study has been carried out for farmers and farm women separately and also for both combined to understand both ecological and gender dimensions. The major objective of the study is to conduct a series of participatory exercises to generate a micro level response data, which are primary in nature under the canopy of the title.
Study Design: The locale was selected by purposive sampling technique and the respondents were selected by the simple random sampling method.

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Place of Study: Four gram panchayats namely Sihar, Deshra Koalpara, Lowgram and Kotulpur of the Kotulpur block of Bankura district in West Bengal were purposively selected for the study.
Methodology: In this study 50 farmers and 50 farm women have been interacted and are selected by the simple random sampling method. A preliminary interview schedule has been administered to understand the knowledge, perception and attitude of the people towards nutritional concept, communication and extension system, malnutrition. The gathered data had been put into multivariate analysis. Statistical Package for the Social Sciences V20.0 (SPSS) of IBM was used for analyzing the correlation analysis, multiple regression analysis, step-down regression analysis, path analysis, canonical covariate analysis and artificial neural network analysis.
Results: Several independent variables like age (x1), functional literacy (x2), family size (x4), no of farm activities (x5), working hour per day (x6), distance of work place from residence (x7), wages received (x8), duration of employment (x9), per capita income (x12), per capita expenditure (x13), deviation of blood pressure (x15), pulse rate (x16), dizziness (x17) and status of drinking water (x18) have been identified as strongest determinants to characterize output variable nutrition (y).
Conclusion: The present study has uniquely landed on the value of some important empirical revelation. It can be concluded that farmers, having low income, are suffering from malnutrition most due to low calorie intake. Ensuring pure drinking water for all in rural areas is still a distant dream. A lot of farm women are suffering from dizziness and anemia due to lack of balanced diet. Malnutrition is still prevalent at significant levels especially in rural areas and the most vulnerable are children, women and elderly especially of lower income groups.

Keywords: Malnutrition; farming community; calorie; income; expenditure; farm women; drinking water.

1. INTRODUCTION

Indian peasantry, the largest body of surviving small farmers in the world, today faces a crisis of extinction. Two thirds of India makes its living from the land [1]. India is often thought of as a development paradox with relatively high economic growth rates in the past few years, but with lower progress in areas of life expectancy, education and standard of living. While serious inequalities in growth, development and opportunity explain the illusion of the paradox at the country level, still, a significant proportion of the world's poor live in India, as do a significant proportion of the world's malnourished children. Poverty and under nutrition coexist, and poor dietary quality is associated with poor childhood growth, as well as significant micronutrient deficiency [2].

Indian women are nutritionally the most vulnerable next to young children in India. Although women are food producers at farm and household level and their own nutrition situation is not very encouraging all over the developing countries including India. Malnutrition is still prevalent at significant levels especially in rural areas and the most vulnerable are children, women and elderly especially of lower income groups. According to the latest round of NFHS-3 (National Family Health Survey), 39 per cent of rural women in the age group of 15 – 49 years suffer from chronic energy deficiency and 58 per cent are anemic [3,4].

The relationship of women's nutrition with birth outcomes and stunting rates of young children is well established and it is imperative that measures for improving nutritional situation in the country is accorded a high priority [5]. In this empirical study an attempt is made to examine the relative importance of some socio-economic and demographic variables that affect the nutrition of the farming community.

The major objectives of the study is i) to isolate and interpret the complete process of a basket of multivariate analytical techniques with a focus on its socio-economical dynamics and neo-patterning subsequence; ii) to study nutrition in form of predicted character against a set of predictors, socio-economic and ecological in nature; iii) to elucidate inter and intra level interaction amongst and between predictors and predicted character and iv) to throw lights on creating a resilient model for better socialization of technology by a new genre of extension research.

2. MATERIALS AND METHODS

The respondents in the study are 50 farmers and 50 farm women of Kotulpur block in West Bengal. Some of them work on the family farm

and some as hired agricultural labors. Four gram panchayats namely Sihar, Deshra Koalpara, Lowgram and Kotulpur of the Kotulpur block of Bankura district in West Bengal were purposively selected for the study. Twenty four villages were selected by random sampling. The area had been selected for the experienced, well versed and venturesome respondents.

Purposive as well as simple random sampling techniques were adopted for this study. For selection of state, district, block and gram Panchayat purposive sampling techniques were adopted because the area was ideal for the study, convenient for the researcher and it had the infrastructural facilities. In case of selection of villages and respondents simple random sampling technique was taken up.

Before taking up actual fieldwork a pilot study was conducted to understand the area, its people, institution, communication and extension system and the knowledge, perception and attitude of the people. An outline of the socio-economic background of the farmers of the concerned villages, their opinion towards different types of technologies, socialization process, natural resources, ecology, health problems, stress related issues, drudgery, nutritional aspects, gender discrimination, conflict and confusion helped in the construction of reformative working tools.

Variables in the present study have been categorized into two main categories.

i) Independent variable
ii) Dependent variable

i) Independent variables

Age (x1), functional literacy (x2), no of children (x3), family size (x4), no of farm activities (x5), working hour per day (x6), distance of work place from residence (x7), wages received (x8), duration of employment (x9), no of animals reared (x10), size of holding (x11), per capita income (x12), per capita expenditure (x13), per capita debt (x14), deviation of blood pressure (x15), pulse rate (x16), dizziness (x17) and status of drinking water (x18).

ii) Dependent variable

Nutrition (y2): Nutrition is the science that interprets the nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. In the present study total calorie intake per day of the respondent is considered as Nutrition (y2). It is calculated as follows-

Nutrition = (a+ b+ c)

Whereas, a = Calorie intake from carbohydrate per day, b = Calorie intake from protein per day, c = Calorie intake from fat per day

3. RESULTS

The qualitative data is quantified by using specific numerical procedure. Then the quantified data were put under five statistical analysis i.e. correlation analysis, multiple regression analysis, step-down regression analysis, path analysis, canonical covariate analysis and artificial neural network analysis. The findings are as follows-

3.1 Correlation Analysis

The co-efficient of correlation was calculated to assess the linear relationship between Nutrition (y) and 18 independent variables. Table 2 presents:

- The independent variable Deviation of blood pressure (x15) has recorded significant correlation with the dependent variable Nutrition (y) for farmers. In case of farm women, Working hour per day (x6), Duration of employment (x9) and Dizziness (x17) have recorded significant correlations with Nutrition (y). Independent variables Functional literacy (x2), Number of farm activities (x5), Wages received (x8), Size of holding (x11) and Dizziness (x17) have recorded significant correlations with the dependent variable Nutrition (y) for the pool data i.e. for the amalgamation of data of male and female respondents.
- Deviation of blood pressure (x15) has been recorded to have the highest r-value for farmers in association with Nutrition (y). Duration of employment (x9) has been recorded to have the highest r-value for farmer women in association with Nutrition (y) and Wages received (x8) has been recorded to have the highest r-value for the pool data i.e. for the amalgamation of data of male and female respondents in association with Nutrition (y).

Table 1. Sampling technique and sampling design for this study

Step	Items	Level	Approach
1	State	West Bengal	Purposive
2	District	Bankura	Purposive
3	Subdivision	Bishnupur	Purposive
4	Block	Kotulpur	Purposive
5	Gram Panchayat	1) Sihar 2) Deshra Koalpara 3) Lowgram 4) Kotulpur	Purposive
6	Respondents	100	Random
Total number of respondents: 100			

3.2 Multiple Regression Analysis

Table 3 presents the multiple regression analysis where in 18 causal variables have been regressed against the consequent variable Nutrition (y) to estimate the functional impact of 18 causal variables on the consequent variable Nutrition (y). Table 4 exerts that-

- For farmers, the R square value is 36.5 per cent, which implies that by the conglomeration of 18 causal variables, 36.5 per cent of variance in the consequent variable, Nutrition (y) has been explained. In other side, per unit change in deviation of blood pressure, negatively, has a reciprocal impact of (-8.584) unit of change in nutritional status of farmers.
- In case of farm women, The R square value is 57.6 per cent, which implies that by the conglomeration of 18 causal variables, 57.6 per cent of variance in the consequent variable, Nutrition (y) has been explained. In other side, per unit change in working hour per day, duration of employment and dizziness, positively or negatively, have a reciprocal impact of (+24.694), (0.699) and (-14.992) unit of change in nutritional status of farm women.
- The R square value being 70.8 per cent for the pool data, it can be inferred that by the conglomeration of 18 causal variables, 70.8 per cent of variance in the consequent variable, Nutrition (y) has been explained. In other side, per unit change in functional literacy, number of farm activities, wages received, size of holding and dizziness, positively or negatively, have a reciprocal impact of (14.548), (28.331), (3.910), (-.075) and (-23.490) unit of change in nutritional status of both farmers and farm women.

3.3 Stepwise Regression Analysis

Table 4 presents the stepwise regression analysis to isolate the variables from 18 causal variables, having dominance of effect on consequent variable, Nutrition (y). It has been found that:

- For farmers, 1 variable Deviation of blood pressure (x15) has been retained in the last step of stepwise regression analysis which implies its critical and effective contribution to the resultant behavior of the variable Nutrition (y). So, this 1 causal variable is very important in optimum resource allocation or strategic importance in management of nutritional aspect of farmers. It has explained 9.4 per cent of the variance from 18 causal variables.
- For farm women, 3 variables Duration of employment (x9), Per capita debt (x14) and Working hour per day (x6) have been retained in the last step of stepwise regression analysis which implies their compact and useful contribution to the resultant behavior of the variable Nutrition (y). So, these 3 causal variables have been the most dominant contributors in estimation of Nutrition (y) of farm women. These 3 causal variables together explained 39.8 per cent of the variance from 18 causal variables.
- In pool data, 3 variables Wages received (x8), Number of farm activities (x5) and Duration of employment (x9) have been retained in the last step of stepwise regression analysis which implies their compact and useful contribution to the resultant behavior of the variable Nutrition (y). So, these 3 causal variables have been the most dominant contributors in

estimation of Nutrition (y) for pool data. These 3 causal variables together explained 65.3 per cent of the variance from 18 causal variables.

3.4 Path Analysis

Table 5 presents the path analysis where in co-efficient of correlation (r) of Nutrition (y) vs. 18 independent variables is being decomposed into the direct, indirect and residual effect.

- For farmers, Per capita expenditure (x13) has exerted both the highest direct and indirect effect. So, the functional and operational contribution of per capita expenditure has been the highest on Nutrition (y) of farmers. The residual effect being 63.384 per cent, it is to conclude that even with a combination of 18 exogenous variables, 63.384 per cent of variance in consequent variable Nutrition (y) of farmers could not be explained.
- In case of farm women, Per capita expenditure (x13) has exerted the highest direct effect and Per capita income (x12) has exerted the highest indirect effect. So, the functional and operational contribution of Per capita income (x12) and Per capita expenditure (x13) has been the highest on Nutrition (y) of farm women. The residual effect being 42.393 per cent, it is to conclude that even with a combination of 18 exogenous variables, 42.393 per cent of variance in consequent variable Nutrition (y) of farm women could not be explained.
- For pool data, Wages received (x8) has exerted the highest direct effect and Per capita expenditure (x13) has exerted the highest indirect effect. So, the functional and operational contribution of Wages received (x8) and Per capita expenditure (x13) has been the highest on Nutrition (y). The residual effect being 29.268 per cent, it is to conclude that even with a combination of 18 exogenous variables, 29.268 per cent of variance in consequent variable Nutrition (y) of pool data i.e. for the amalgamation of data of male and female respondents could not be explained.

Table 2. Comparative study of the co-efficient of correlation (r) among dependent variable Nutrition (y) and 18 independent variables (x1-x18)

Sl. No.	Variables	r value (Farmers)	r value (Farm women)	r value (Pool data)
1.	Age (x1)	-.162	-.159	.058
2.	Functional literacy (x2)	.045	.077	.340**
3.	Number of children (x3)	-.055	-.253	-.095
4.	Family size (x4)	-.116	-.131	.163
5.	Number of farm activities (x5)	.183	.202	.628**
6.	Working hour per day (x6)	.143	.442**	-.116
7.	Distance of work place from residence (x7)	.096	.031	-.049
8.	Wages received (x8)	.195	.066	.706**
9.	Duration of employment (x9)	.222	.459**	.557**
10.	Number of animals reared (x10)	.130	.037	.064
11.	Size of holding (x11)	-.013	-.161	.397**
12.	Per capita income (x12)	-.046	.021	.140
13.	Per capita expenditure (x13)	-.122	.058	.141
14.	Per capita debt (x14)	-.230	.277	.169
15.	Deviation of blood pressure (x15)	-.306*	-.094	-.179
16.	Pulse rate (x16)	-.260	.183	.084
17.	Dizziness (x17)	-.117	-.318*	-.320**
18.	Status of drinking water (x18)	.005	-.168	.162

**Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level*

3.5 Canonical Analysis

- Figs. 1 and 2 presents the canonical analysis between independent and dependent variables to derive the interaction pattern between two sets of variables based on mutual and reciprocal regression for farmers and farm women respectively. Here the two set of variables (x and y) have recorded the respective choices and conglomeration along and across the line of interaction.
- For farmers, it has been found that variable Health of farmers (y1) has made an isochronous movement and recorded a clandestine selection of variables Number of children (x3), Family size (x4), Number of farm activities (x5), Working hour per day (x6), Per capita income (x12), Deviation of blood pressure (x15), Dizziness (x17) and Status of drinking water (x18). On the contrary, variables Nutrition of farmers (y2), Physical hygiene of farmers (y3) and Mental hygiene of farmers (y4) have got a precise selection of variables Age (x1), Functional literacy (x2), Distance of work place from residence (x7), Wages received (x8), Duration of employment (x9), Number of animals reared (x10), Size of holding (x11), Per capita expenditure (x13), Per capita debt (x14) and Pulse rate (x16). The variables Nutrition of farmers (y2), Physical hygiene of farmers (y3) and Mental hygiene of farmers (y4) have formed a triad to infer a mutually reciprocated character of hygiene issues with psychosocial status of farmers.
- For farmer women, it has been found that variables Health of farm women (y1), Nutrition of farm women (y2) and Mental hygiene of farm women (y4) have made an isochronous movement and recorded a clandestine selection of variables Functional literacy (x2), Family size (x4), Number of farm activities (x5), Distance of work place from residence (x7), Wages received (x8), Duration of employment (x9), Number of animals reared (x10), Size of holding (x11), Per capita income (x12), Per capita debt (x14), Pulse rate (x16) and Dizziness (x17). On the contrary, variable Physical hygiene of farm women (y3) has got a precise selection of variables Age (x1), Number of children (x3), Working hour per day (x6), Per capita expenditure (x13), Deviation of blood pressure (x15), Menstrual problem (x18), Status of drinking water (x19) and Menstrual hygiene (x20). The variables Health of farm women (y1), Nutrition of farm women (y2) and Mental hygiene of farm women (y4) have formed a triad to infer a mutually reciprocated character of physical problems with psychosocial status of farm women.

3.6 Artificial Neural Network Analysis

- Fig. 3 depicts the artificial neural network analysis of Nutrition (y) vs. 21 input variables for farmers. Here five input variables Age (x1), Per capita income (x12), Per capita expenditure (x13), Pulse rate (x16) and Mental hygiene of farmers (y4) are passed through the hidden layers and after been activated Nutrition of farmers. So, these variables have been identified as strongest determinants to characterize output variable Nutrition of farmers.
- Fig. 4 depicts the artificial neural network analysis of Nutrition (y) vs. 21 input variables for farm women. Here eleven input variables Age (x1), Family size (x4), Working hour per day (x6), Wages received (x8), Duration of employment (x9), Number of animals reared (x10), Size of holding (x11), Per capita income (x12), Per capita debt (x14), Physical hygiene of farm women (y3) and Mental hygiene of farm women (y4) are passed through the hidden layers and after been activated Nutrition of farm women. So, these variables have been identified as strongest determinants to characterize output variable Nutrition of farm women.
- Fig. 5 depicts the artificial neural network analysis of Nutrition (y) vs. 21 input variables for pool data. Here eleven input variables Age (x1), Functional literacy (x2), Family size (x4), Number of farm activities (x5), Distance of work place from residence (x7), Wages received (x8), Pulse rate (x16), Dizziness (x17) and Status of drinking water (x18) are passed through the hidden layers and after been activated Nutrition. So, these variables have been identified as strongest determinants to characterize output variable Nutrition of pool data i.e. for the amalgamation of data of male and female respondents.

Table 3. Comparative study of the multiple regression analysis among nutrition (y) and 18 causal variables (x1-x18)

Sl. No.	Variables	Regression Coefficient (Farmers) *	Regression Coefficient (Farm women) **	Regression Coefficient (Pulled data) ***
1.	Age (x1)	-2.718	4.201	6.458
2.	Functional literacy (x2)	4.813	-12.386	14.548
3.	Number of children (x3)	40.307	-31.147	-15.663
4.	Family size (x4)	-40.250	-21.198	-7.934
5.	Number of farm activities (x5)	8.793	19.401	28.331
6.	Working hour per day (x6)	14.948	24.694	-4.683
7.	Distance of work place from residence (x7)	14.989	-2.108	17.428
8.	Wages received (x8)	.399	2.981	3.910
9.	Duration of employment (x9)	.056	.699	.978
10.	Number of animals reared (x10)	-.599	5.718	1.777
11.	Size of holding (x11)	.652	-1.707	-.075
12.	Per capita income (x12)	.020	-.015	.011
13.	Per capita expenditure (x13)	-.028	.013	-.015
14.	Per capita debt (x14)	-.012	.031	.012
15.	Deviation of blood pressure (x15)	-8.584	-1.527	-4.041
16.	Pulse rate (x16)	-7.584	6.255	5.200
17.	Dizziness (x17)	2.488	-14.992	-23.490
18.	Status of drinking water (x18)	12.914	-9.988	6.641

** R square: 36.5 per cent; ** R square: 57.6 per cent; *** R square: 70.8 per cent*

4. DISCUSSION

It has been observed that an increasing number of people are falling below the recommended levels of total calorie intakes over 1993-94 to 2009-10 [6]. Table 6 shows that quantity consumption of different food groups like cereals, pulses and vegetables as well as protein intake has been declined over the period of 1993-94 to 2009-10. It also shows the proportions of these food items in total food. These average figures support the notion that as calorie intake declines over time, people have moved away from basic foods to high-value foods [7]. On the other hand, quantity consumption of high value food items (non-veg food items and fruits) has either remained same or has increased (as in case of milk).

Analyzing the data collected from male respondents (farmers), it can be exerted that the independent variable deviation of blood pressure (x15) has got discernable effect on nutritional status of farmer as it has come out as important and effective variable in correlation, multiple regression and stepwise regression analysis. Aside from age, body mass index (BMI) had the strongest association with blood pressure level. Furthermore, after multiple adjustments, BMI persisted as the main contributory modifiable factor in the systolic blood pressure [11].

Table 4. Comparative study of the stepwise regression analysis

Particulars	Variables	Regression Coefficient	S. E. B	Beta	t Value	R square
Farmers	Deviation of blood pressure (x15)	-13.790	6.185	-.306	-2.230	9.4%
Farm women	Duration of employment (x9)	.872	.292	.383	2.990	39.8%
	Per capita debt (x14)	.035	.012	.340	2.943	
	Working hour per day (x6)	23.817	10.453	.289	2.278	
Pool data	Wages received (x8)	4.696	.659	.490	7.128	65.3%
	Number of farm activities (x5)	35.210	9.038	.289	3.896	
	Duration of employment (x9)	.842	.266	.225	3.160	

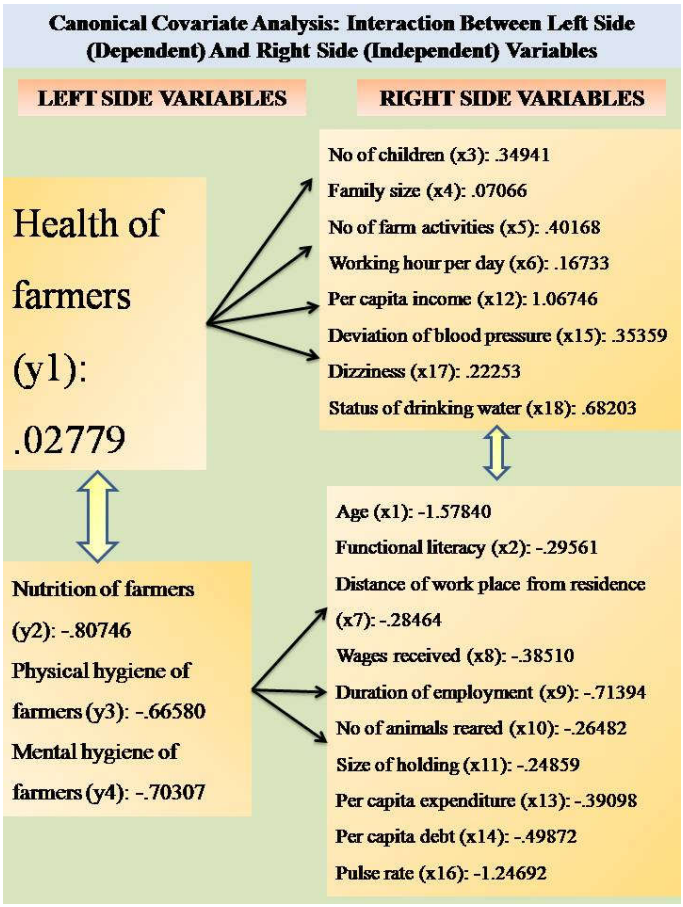

Fig. 1. Canonical analysis of data collected from male respondents

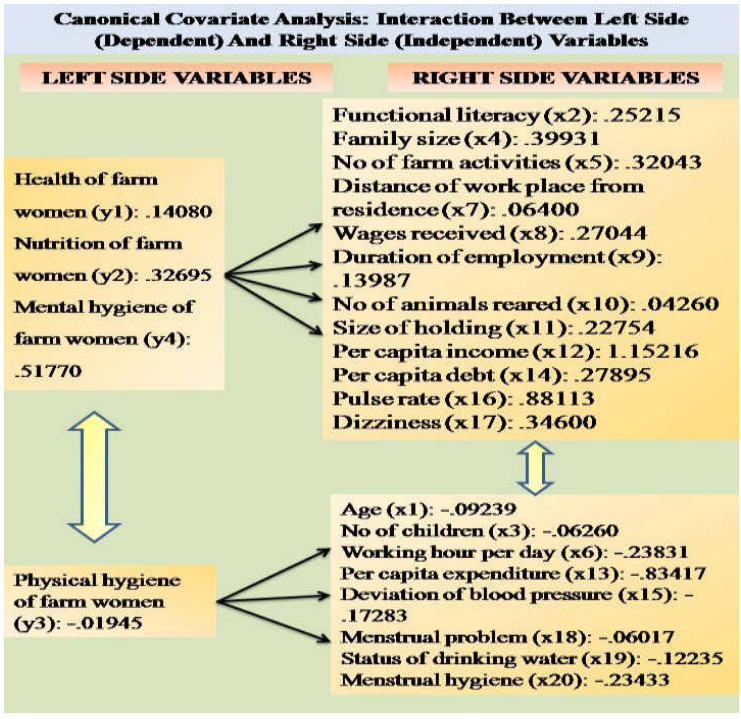

Fig. 2. Canonical analysis of data collected from female respondents

Table 5. Comparative study of path analysis of nutrition (y) vs. 18 exogenous variables (x1-x18)

Sl. No.	Variables	Farmers*		Farm women**		Pulled data***	
		Direct effects	Indirect effects	Direct effects	Indirect effects	Direct effects	Indirect effects
1.	Age (x1)	-0.187	0.02501	0.286	-0.445	0.25	-0.19201
2.	Functional literacy (x2)	0.06	-0.01499	-0.147	0.22399	0.106	0.23399
3.	Number of children (x3)	0.219	-0.274	-0.18	-0.073	-0.048	-0.047
4.	Family size (x4)	-0.408	0.29199	-0.214	0.083	-0.046	0.20902
5.	Number of farm activities (x5)	0.128	0.055	0.121	0.081	0.233	0.39499
6.	Working hour per day (x6)	0.209	-0.06599	0.3	0.14203	-0.035	-0.081
7.	Distance of work place from residence (x7)	0.135	-0.039	-0.019	0.05001	0.085	-0.13401
8.	Wages received (x8)	0.056	0.13899	0.271	-0.20501	0.406	0.30001
9.	Duration of employment (x9)	0.026	0.19602	0.308	0.151	0.261	0.29601
10.	Number of animals reared (x10)	-0.028	0.158	0.23	-0.19298	0.043	0.02098
11.	Size of holding (x11)	0.15	-0.16299	-0.266	0.105	-0.009	0.406
12.	Per capita income (x12)	1.014	-1.06	-0.64	0.66102	0.257	-0.11699
13.	Per capita expenditure (x13)	-1.186	1.064	0.479	-0.42099	-0.311	0.45203
14.	Per capita debt (x14)	-0.144	-0.08601	0.293	-0.01602	0.076	0.09299
15.	Deviation of blood pressure (x15)	-0.189	-0.117	-0.047	-0.04699	-0.062	-0.11701
16.	Pulse rate (x16)	-0.131	-0.12902	0.109	0.074	0.05	0.034
17.	Dizziness (x17)	0.027	-0.14401	-0.207	-0.111	-0.18	-0.14
18.	Status of drinking water (x18)	0.095	-0.09	-0.064	-0.104	0.025	0.137

** Residual effect: 63.384 per cent; ** Residual effect: 42.393 per cent; *** Residual effect: 29.268 per cent*

Table 6. Average intake of calories (kcal) from different food groups and total protein intake, 1993-94 to 2011-12

Food groups	Rural				Urban			
	1993-94	2004-05	2009-10	2011-12	1993-94	2004-05	2009-10	2011-12
Total calories	2154 (60)*	2047 (56)*	2020 (54)*	2099 (57)*	2073 (57)*	2020 (55)*	1982 (53)*	2058 (56)*
Cereals	1534	1385	1298	1285	1216	1135	1072	1065
Pulses	92	81	76	90	105	95	92	105
Vegetables	83	85	78	84	89	87	78	80
Non-veg	15	16	15	17	21	21	20	23
Milk	132	131	137	148	166	174	184	187
Oil	115	151	172	189	182	214	232	250
Fruits	20	23	20	24	37	36	34	36
Snacks etc	26	30	98	123	85	76	119	147

*Source: NSS data [8,9,10]; * Figures in parentheses show protein content in g*

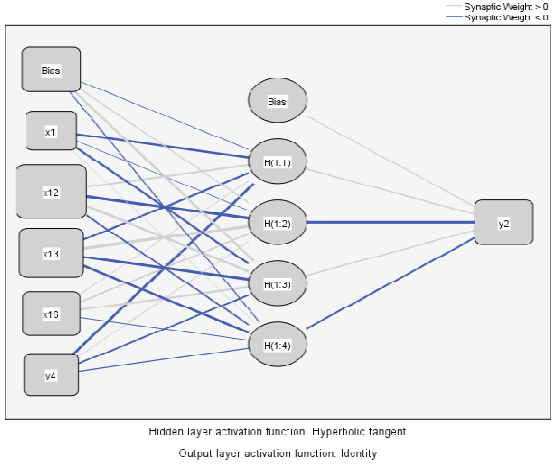

Fig. 3. Artificial neural network analysis of data collected from male respondents

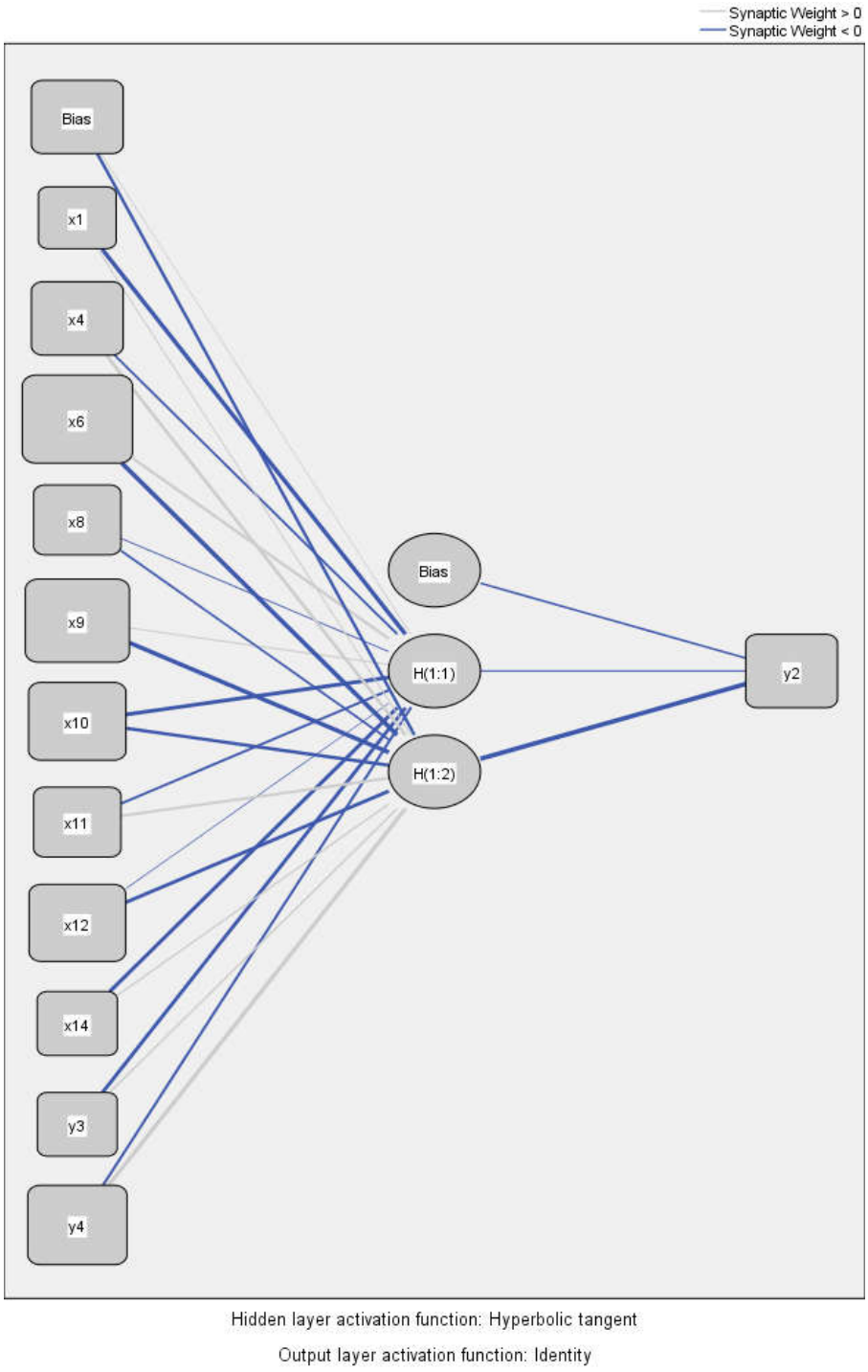

Fig. 4. Artificial neural network analysis of data collected from female respondents

Salt consumption is a major nutritional factor associated with blood pressure level [12,13]. Intake of fruits and vegetables is known to be associated with lower blood pressure level [14,15,16]. This association has been explained by the high potassium and fiber contents of these foods, which have been shown to reduce blood pressure levels [17,18]. The relationship between blood pressure and sodium-to-potassium ratio has been shown to be stronger than the relationship between blood pressure and either sodium or potassium alone [19].

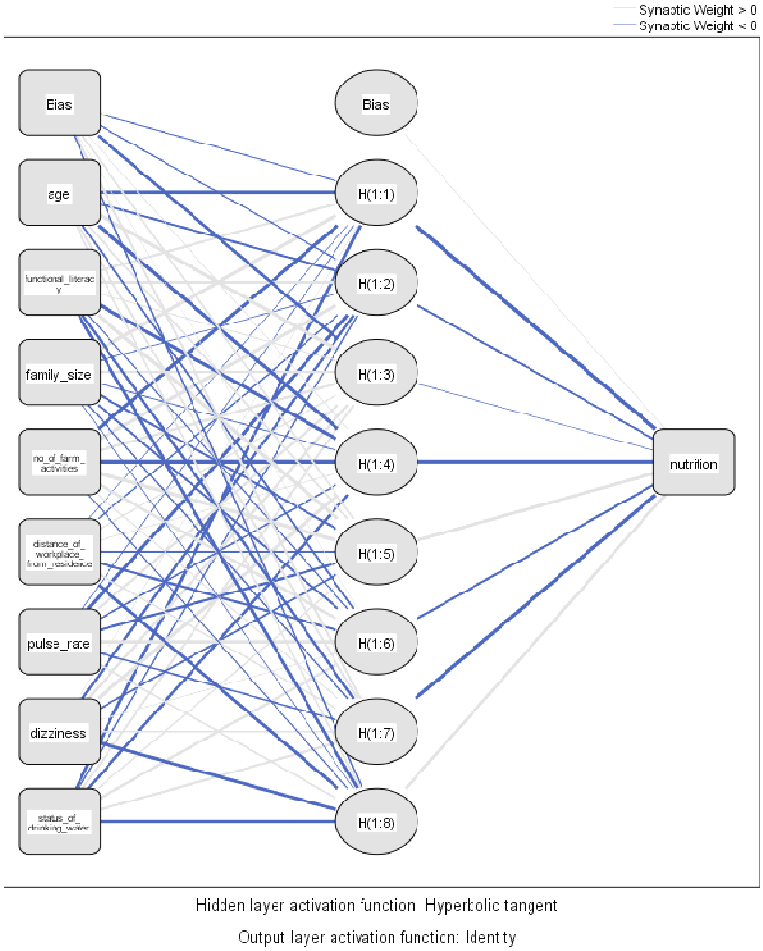

Fig. 5. Artificial neural network analysis of pool data

Independent variables per capita income (x12), per capita expenditure (x13) and per capita debt (x14) are coming up as prime determinants of nutritional status by analyzing the data collected from male respondents (farmers), female respondents (farm women) and pool data. The inter-relationships between poverty and nutrition are well known; poverty restricts access to food required to meet daily requirements or ensure dietary diversity and thus leads to malnutrition, while malnutrition can adversely affect educational and economic attainments, thus perpetuating poverty. Therefore, in the existing scenario of unequal growth and poverty, it is not surprising that the burden of malnutrition in India remains high; there is therefore no surprising paradox in the coexistence of relatively high aggregated growth rates and high rates of malnutrition [20].

Micronutrient deficiencies are commonly encountered in India, exemplified by iron deficiency manifesting as anemia. Inadequate dietary iron, low folate and vitamin B-12 intake and poor bioavailability of dietary iron from the fibre and phytate rich Indian diets are some important factors associated with the high prevalence of anemia in India [21,22,23]. Expenditure on food is a mirror image of a household's income and resources. With improvement of household income, absolute expenditure on food is likely to go up, as is the calorie and protein intake of the household [24]. However, if the household has limited purchasing power, the per capita intake will be less.

Independent variables Working hour per day (x6), Wages received (x8), Duration of employment (x9) and Size of holding (x11) are coming up as prime determinants of nutritional status by analyzing the data collected from female respondents (farm women) and pool data. Wages are key aspects of quality of work and a major component of income. The wage rate is amongst the most important means to ensure livelihoods of people and income distribution

among citizens in any society. Wages are also a powerful tool for improving equality and equity in an economy and societal sustainability [25]. It is quite obvious that wages received also depends upon working hour per day and duration of employment. Per capita income of a household also depends upon their size of holding as well as productivity. As these 4 variables have huge impact on income and expenditure of an individual, these are also responsible for nutritional status.

Analyzing the data collected from male respondents (farmers) and pool data, it can be exerted that the independent variable Pulse rate (x16) has got discernable effect on nutritional status. Although it is clear that diet influences pulse or heart rate; the mechanisms and pathways underlying such effects are multi factorial. Furthermore the link between heart-rate variability (the time differences between one beat and the next) and pathological eating behaviors points towards the possibility of mutual causation [26].

Independent variable Age (x1) has exerted as one of the prime determinants of nutritional status by analyzing the data collected from male respondents (farmers), female respondents (farm women) and pool data. Increasing age can be strongly and independently correlated with poor nutritional status [27]. There is a growing recognition that age-related physiological anorexia may predispose to protein-energy under nutrition in older persons, particularly in the presence of other pathological factors associated with aging [28,29].

Meeting the diet and nutrition needs of older people is crucial for the maintenance of health, functional independence and quality of life [30]. Older people are vulnerable to malnutrition which is associated with an increased risk of morbidity and mortality [31]. Increased falls, vulnerability to infection, loss of energy and mobility, poor wound healing and confusion are reported consequences of under nutrition [32].

Independent variable Status of drinking water (x18) has exerted as one of the prime determinants of nutritional status by analyzing pool data. As a food, water has a particular composition and may be consumed as such or be included as an ingredient in a dish. Water also has non-food roles that affect nutrition. Being a nutrient means that water is a chemically defined molecule contained in foods with certain functions in the human body [33].

Safe and clean water is an important element of a health promoting environment. Lack of such an environment is one of the underlying causes of malnutrition [34]. Poor household water supply could affect nutrition via the effect of diseases associated with water. Pesticides (e.g. DDT, chlorpyrifos and pyriproxyfen) and disinfectants (e.g. bromate and trihalomethanes) are among the chemicals that constitute waterborne hazards [35,36,37,38]. Unsafe and contaminated water can be associated with numerous diseases. The microbiological quality of drinking water concerns consumers, water suppliers, regulators and public health authorities.

Independent variable Number of farm activities (x5), Distance of work place from residence (x7) and Dizziness (x17) have exerted as prime determinants of nutritional status by analyzing the data collected from female respondents (farm women) and pool data. Eating patterns have been considered risk factors for various metabolic and circulatory changes that cause several symptoms including dizziness, especially among elderly individuals [39,40]. *Dizziness* is a change in balance characterized by the illusion of movement of the individual or the environment that surrounds them.

The prevalence of malnutrition is increasing in this population and is associated with declines in functional status, impaired muscle function, decreased bone mass, immune dysfunction, anemia, reduced cognitive function, poor wound healing, delayed recovery from surgery, higher hospital readmission rates, and mortality [41]. There is a connection between intake of some vitamins and minerals and dizziness. A sudden drop in Vitamin B6, Vitamin B12, Vitamin D, potassium, iron and excess intake of Vitamin A can lead to dizziness. Increasing number of farm activities (x5) and long distance of work place from residence covered by the farm women (x7) also affect dizziness as well as nutritional status due to drudgery, extreme workload and lack of timely feeding.

Independent variable Family size (x4) has come out as one of the prime determinant of nutritional status by analyzing the data collected from female respondents (farm women) and pool data. Increased family size may adversely affect the nutritional status of every member of the household because it may be associated with

decreased per capita human inputs. Increased household size also implies acceptance of lower quality/ quantity models of fertility decision [42]. The prevalence of food security among households with large family size is high and these families with poor child care practices are more likely to have malnourished children [43].

Independent variable Functional literacy (x2) has come out as one of the prime determinant of nutritional status by analyzing the data collected from pool data. Farmers and farm women, having much education are able to take balanced diet than those who have less education and knowledge about nutrition by consuming more protein, fruits, vegetables and less carbohydrate. More education is associated with greater awareness of children's needs and better child-care practices. Better educated parents should be able to provide their children with a more nutritious diet at any income level because of their increased knowledge [44].

5. CONCLUSION

While addressing problems of a nutritional nature, holistic and multi-sectoral interventions are required, including attention to the immediate, underlying and basic causes of the manifestation. *Malnutrition* can be defined as a state in which a deficiency, excess, or imbalance of energy, protein, and other nutrients causes adverse effects on body form, function, and clinical outcome [45]. To evolve an appropriate policy to combat the nutritional issues of farming community, it is essential to assess not only the magnitude of the problem but also the factors affecting it. The nutritional status of an individual is the outcome of a complex interaction of a broad range of host and environmental factors, with the latter encompassing physical, biological, and especially cultural influences. This empirical study has been carried out in both ecological and gender dimensions. The study has been done for farmers and farm women separately and also for both combined. Farmers, having low income, are suffering from malnutrition most. Ensuring pure drinking water for all in rural areas is still a distant dream. A lot of farm women are suffering from dizziness and anemia due to lack of balanced diet. Malnutrition is still prevalent at significant levels especially in rural areas and the most vulnerable are children, women and elderly especially of lower income groups. Good nutrition may contribute significantly to the health and well being of older individuals, and to their ability to recover from illness. Other economic issues i.e. wages and income of farmers and farm labors should be raised to support their family. Otherwise, they have got no choice but to run under uncertain and repressive economy. Much of policy coverage and implication for the well-being and livelihood upliftment of farming community specifically women haven't been found. The government has to take clear cut and well directed policies for supporting farmers and farm women along with their children.

CONSENT

As per international standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

All experiments have been examined and approved by the appropriate ethics committee.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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