

## **Role of livestock in integrated farming in coastal saline zone of West Bengal**

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### **ABSTRACT**

The present study was performed in the form of a survey comprising 240 farmers of South 24 Parganas, West Bengal falling under coastal saline zone in order to assess the role of livestock rearing in rural economy compared to other farm enterprises. Data were obtained by personal interview with a pre-structured tested schedule. The farmers were divided into different categories based on size of land holding viz marginal (<0.5 H), small (>0.5 H and <1 H), medium (>1 H and <1.5 H) and large (>1.5 H). Level of crop diversification, pattern of animal rearing and income from individual sector were compared with increase in size of land holding. The per cent allocation of gross cropped area was maximum for cereals (64.12) followed by pulses (17.76%) and vegetables (8.09%) the trend being similar for all categories of farmers. Number of farmers with high level of crop diversification decreased as the size of land holding increased, being maximum (19.1%) for marginal farmers. This could be due to greater investment on labour and capital with the increase in the size of land holding. Non-descript (Desi) cows constituted the major population of dairy animals followed by cross-breds while dairy buffalos were unpopular in this part. The reason for such a trend could be that the maintenance of Desi cows required far less care as they were more disease resistant and thus family labour could be deployed for other farm activities. Unattractive price of milk compared to high price of concentrates and lack of good quality fodder were also hindrances towards maintenance of cross-breds. In overall livestock constituted 18.08 per cent of total income of marginal farmers while its share was only 8 per cent for large farmers. This indicates that livestock enterprise is a subsidiary enterprise which may add to the farm income.

**Keywords:** Coastal saline zone; crop; integrated farming; livestock

### **INTRODUCTION**

In India, agriculture and allied activities despite their falling shares in gross domestic product are central to livelihood of millions of rural people. About 72 per cent

of India's population is in villages and 75 per cent of it depends on agriculture and allied activities for livelihood (Birthal and Taneja 2006). However industrialization and burgeoning population are leading to shrinkage of agricultural land as well as

operational holdings. Globalization of market and change in agriculture trade and tariff policies call for drastic innovative changes of existing farming systems. In this era of stagnation and falling profitability of crop farming (Kumar et al 2006, Narayanamoorthy 2006) dairy has been adopted as a subsidiary occupation by the peasantry of Punjab. Thus it is imperative to integrate agriculture with dairy, fishery, poultry etc in a profitable manner.

The whole of coastal region of West Bengal is affected by the problem of salinity to varying extent and comes under coastal saline zone. Almost whole area of South 24 Parganas district comes under this agro-climatic zone. Due to water logging during the rainy season high soil salinity and lack of irrigation during summer this area has been identified as constrain zone for agriculture and fodder cultivation (Anon 1984). Therefore the potential of livestock in coastal saline zone of West Bengal was studied with specific objectives of finding out the composition of livestock in different farming systems, working out the relative share of different components in the total farm income and examining the constraints and prospects of integrated farming system.

## METHODOLOGY

In total 240 farmers were selected randomly from six blocks of South 24 Parganas falling under coastal saline zone of West Bengal in 2009-10. Data were

obtained through personal interview with the help of pre-tested structured schedule. The farmers were divided into different categories based on size of land holding viz marginal (£0.5 ha), small (>0.5 ha and £1 ha), medium (>1 H and £1.5 ha) and large (>1.5 ha). Farming systems were identified on the basis of highest income attained from different farm enterprises. Crop diversification index was calculated by using Simpson index of diversity (Joshi et al 2003).

$$\text{Simpson index of diversity } (I_i) = \frac{1 - (\sum_i S_i^2)}{(\sum_i S_i)^2}$$

where  $S_i$  is the share of crop 'i' in gross crop area

A high Simpson index indicates greater crop diversity while a low index reflects more specialization. Diversification index greater than 0.7 was considered as high and lower than 0.5 was considered as low for different categories of farmers.

Data were analysed by repeated measures ANOVA, ordinary least square analysis, t-test, chi-square test or Duncan's Multiple Range Test using SPSS 8 software.

## RESULTS and DISCUSSION

### Land allocation pattern

In coastal saline zone the average size of operational holding varied from 0.31 ha for marginal farmers to 1.83 ha for large

farmers. The size of land holding for marginal to large farmers was much lesser in West Bengal compared to Uttar Pradesh (Singh and Gangwar 2010) due to land reform policies adopted by government of West Bengal during 1978 to 1991 (Banerjee et al 2002).

The allocation of gross cropped area was maximum for cereals followed by pulses and vegetables the trend being similar for all categories of farmers (Table 1). There was no significant difference in share of gross cropped area allocated to cereals among different categories of farmers unlike in Uttar Pradesh (Singh and Gangwar 2010) where share of gross cropped area toward cereals declined from marginal to large farmers. However such comparison between the two states does not hold good as difference in land holding size between marginal and large farmer in West Bengal was not as large as in Uttar Pradesh (0.66 ha for marginal farmers to 7.44 ha for large farmers). Moreover farmers of coastal saline zone of West Bengal were compelled to paddy cultivation during monsoon due to water-logged conditions rendering cultivation of other crops impossible. Allocation of land towards pulses was significantly greater for medium and large farmers compared to marginal farmers (Table 1) as pulses required greater capital investment.

Cropping intensity decreased from marginal to large farmers in the study zone. This could be due to the fact that as size of land holding decreased farmers had a

tendency to maximise farm income through greater use of land and labour. On the other hand dearth of labour and greater capital investment refrained large farmers from greater land usage.

### **Level of crop diversification**

Number of farmers with high level of crop diversification decreased as the size of land holding increased (Fig 1) being maximum (19.1%) for marginal farmers (Table 2). This could be due to greater investment on labour and capital as size of land holding increased. Maximum number of farmers was with high level of crop diversification in cereal-based farming system (23%) and lowest in vegetable-based farming system (4% in medium level of crop diversification, Table 2). Level of crop diversification decreased with increasing livestock population (Fig 2). This could be due to greater income from vegetables and livestock refraining farmers from greater crop diversification.

### **Pattern of livestock rearing**

Pattern of livestock rearing revealed that population of livestock increased with increase in size of land holding (Fig 3). This could be due to the fact that livestock ensures best utilization of agricultural by-products thus maximizing the farm income. Among livestock, pig and sheep rearing was not popular (Table 3) partly due to religious sentiments and also due to lack of demand of mutton compared to chevon. Non-descript (Desi) cows constituted the major population of dairy

Table 1. Cropping pattern of sample households in coastal saline zone of West Bengal (in % of gross cropped area allocated to different crop enterprises replicated for each farmer)

| Particulars             | Total              | Marginal<br>(£0.5 ha) | Small<br>(>0.5 to £1 ha) | Medium<br>(>1 to £1.5 ha) | Large<br>(>1.5 ha)  | Significance |
|-------------------------|--------------------|-----------------------|--------------------------|---------------------------|---------------------|--------------|
| N                       | 240.00             | 89.00                 | 101.00                   | 40.00                     | 10.00               | NS           |
| Cereals                 | 64.12 <sup>t</sup> | 65.13                 | 62.69                    | 67.07                     | 61.58               | NS           |
| Pulses                  | 17.76 <sup>s</sup> | 13.11 <sup>a</sup>    | 20.55 <sup>b</sup>       | 16.9 <sup>b</sup>         | 20.49 <sup>b</sup>  | **           |
| Vegetables              | 8.09 <sup>c</sup>  | 9.55                  | 7.21                     | 6.95                      | 8.66                | NS           |
| Oilseeds                | 3.88 <sup>mq</sup> | 5.22                  | 3.8                      | 2.79                      | 3.7                 | NS           |
| Fishery                 | 4.75 <sup>qr</sup> | 5.61                  | 4.85                     | 3.23                      | 5.31                | NS           |
| Others                  | 1.4 <sup>p</sup>   | 1.37                  | 0.9                      | 3.05                      | 0.27                | NS           |
| Gross cropped area (ha) | 1.17               | 0.55                  | 1.28                     | 1.97                      | 2.63                | -            |
| Net cropped area (ha)   | 0.69               | 0.31                  | 0.74                     | 1.20                      | 1.83                | -            |
| Cropping intensity      | 169.57             | 181.25 <sup>c</sup>   | 175.05 <sup>b</sup>      | 163.62 <sup>ab</sup>      | 142.84 <sup>a</sup> | *            |

\*Significant at 5%, \*\*Significant at 1%, a, b= Similar alphabets along rows denote homogeneous (P > 0.05) shares (Duncan's test)  
p, q, r, s, t= Similar alphabets along column denote homogenous (P > 0.05) shares (least significant difference test)

## Livestock's role in integrated farming

Table 2. Number of farmers with different levels of crop diversification

| Category of farmers                | # of households in different levels of diversification |                       |             |       |
|------------------------------------|--------------------------------------------------------|-----------------------|-------------|-------|
|                                    | Low (£0.5)                                             | Medium (>0.5 to £0.7) | High (>0.7) | Total |
| <b>According to land holding</b>   |                                                        |                       |             |       |
| Marginal                           | 46 (51.7%)                                             | 26 (29.21%)           | 17 (19.1%)  | 89    |
| Small                              | 58 (57.43%)                                            | 30 (29.70%)           | 13 (12.87%) | 101   |
| Medium                             | 21 (52.5%)                                             | 12 (30%)              | 7 (17.5%)   | 40    |
| Large                              | 7 (70%)                                                | 2 (20%)               | 1 (10%)     | 10    |
| <b>According to farming system</b> |                                                        |                       |             |       |
| Cereals                            | 66 (41%)                                               | 58 (36.02%)           | 37 (23%)    | 161   |
| Vegetables                         | 33 (89.19%)                                            | 4 (10.81%)            |             | 37    |
| Fishery                            | 9 (81.82%)                                             | 0                     | 2 (18.18%)  | 11    |
| Livestock                          | 13 (65%)                                               | 7 (35%)               | 0           | 20    |
| Others                             | 11 (100%)                                              | 0                     | 0           | 11    |

Data analysed by Chi-square test

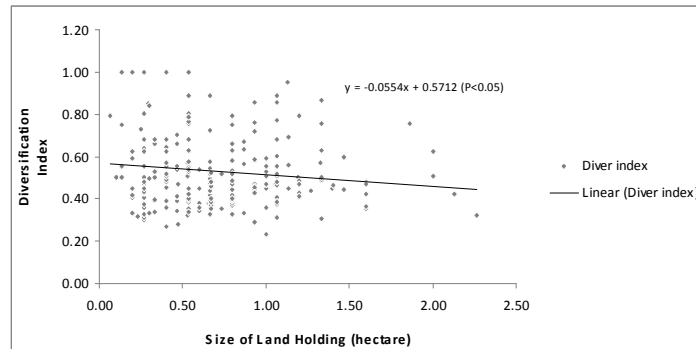


Fig 1. Size of land holding influencing level of crop diversification in coastal saline zone of West Bengal

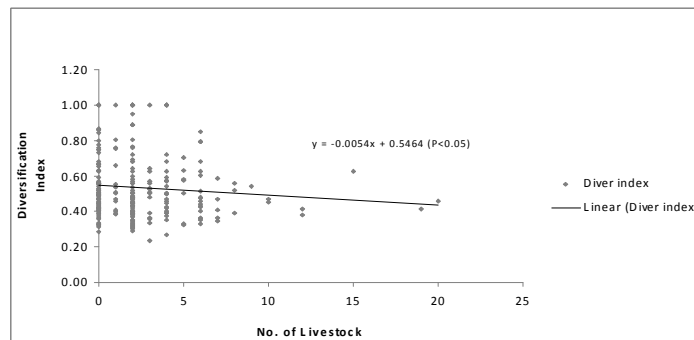


Fig 2. Number of livestock influencing level of crop diversification in coastal saline zone of West Bengal

animals followed by cross-breds while dairy buffalos were unpopular in this part (Table 3). The reason for such a trend as put forward by the farmers was that maintenance of Desi cows required far less care as they were more disease resistant and thus family labour could be deployed for other farm activities. Unattractive price of milk compared to high price of concentrates and lack of good quality fodder were hindrances towards maintenance of cross-breds. Moreover farmers were disinterested in maintaining dairy buffalos due to greater capital investment. This called for strengthening cross-breeding programmes and milk cooperatives.

Among other livestock, goat (0.62) and poultry (3.31) were highly popular in this zone. Number of goats reared per farmer was significantly greater for large farmers (1.7) compared to marginal farmers (0.26) however such trend was not observed for other categories of livestock. Goats were reared mainly by tethering and they picked almost all of their nutritional requirement from local grasses. However as number of goats increased tethering could no longer support their nutritional requirement. Herein large farmers were in a better position to maintain large flocks as they could supplement the yearly nutritional requirement through agricultural by-products. The large farmers did not possess bullocks due to the fact that all of them used power tillers for ploughing.

### **Farm income**

Net income from crop production and livestock production was calculated after deducting total cost from the gross income. The farmers were then classified into farming systems according to the category of enterprise giving maximum return. Out of total farmers surveyed (n=240) the farmers falling into cereal-based, vegetables-based, livestock-based and fishery-based farming system were 67, 37.15, 20.8 and 11.5 per cent respectively (Fig 4) the difference among them being significant.

In general per farmer total farm income was positively related with the size of holding ie as the size of holding increased the per capita income also increased (Table 4). The per capita farm income increased from Rs 30764.65 in case of marginal farmers to Rs 118367.9 for large farmers. In overall livestock constituted 18.08 per cent of total income of marginal farmers while its share was only 8 per cent for large farmers. Similar type of observations were made by Singh et al (2009) while working in western Uttar Pradesh where livestock constitutes 39 and 8 per cent of total income of marginal farmers and large farmers respectively. This indicates that livestock enterprise is a subsidiary enterprise which may add to the farm income. The share of livestock in net farm income ranged from 11.57 per cent in cereal-based farming system to 38.45 per cent in livestock-based farming system. It indicates that there was potential for further growth in these sectors.

# Livestock's role in integrated farming

Table 3. Farm size-wise livestock pattern of households in different study zones (# of animals/farmer in each category)

| Category of livestock  | Total<br>(n= 240) | Marginal<br>(n= 89) | Small<br>(n= 101) | Medium<br>(n= 40)   | Large<br>(n= 10) | Significance |
|------------------------|-------------------|---------------------|-------------------|---------------------|------------------|--------------|
| Milch cow (cross bred) | 0.07              | 0.08                | 0.04              | 0.05                | 0.30             | NS           |
| Milch cow (local)      | 0.95              | 0.83                | 0.96              | 1.13                | 1.20             | NS           |
| Dairy buffaloes        | 0                 | 0.00                | 0.00              | 0.00                | 0.00             | NS           |
| Bullock                | 0.08              | 0.06                | 0.12              | 0.05                | 0                | NS           |
| Calf                   | 0.83              | 0.68                | 0.87              | 0.98                | 1.20             | NS           |
| Goat                   | 0.62              | 0.26 <sup>a</sup>   | 0.81 <sup>a</sup> | 0.65 <sup>a,b</sup> | 1.7 <sup>b</sup> | P <0.05      |
| Sheep                  | 0                 | 0.00                | 0.00              | 0.00                | 0.00             | NS           |
| Pig                    | 0                 | 0.00                | 0.00              | 0.00                | 0.00             | NS           |
| Poultry                | 3.31              | 3.71                | 3.10              | 3.26                | 3.10             | NS           |

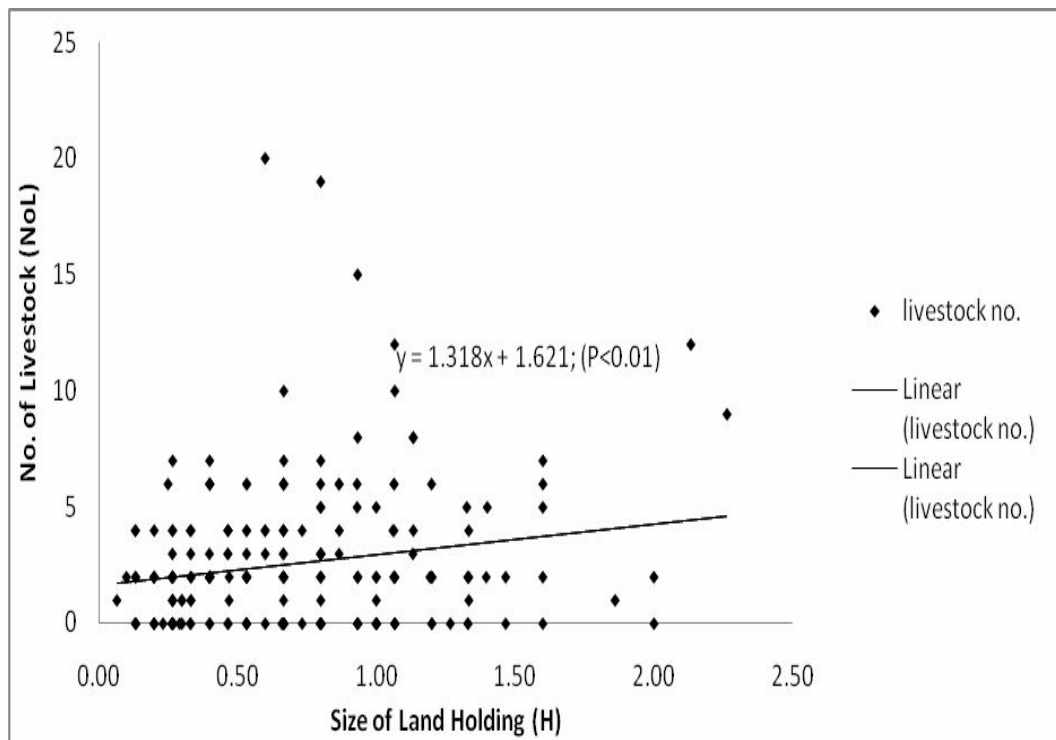


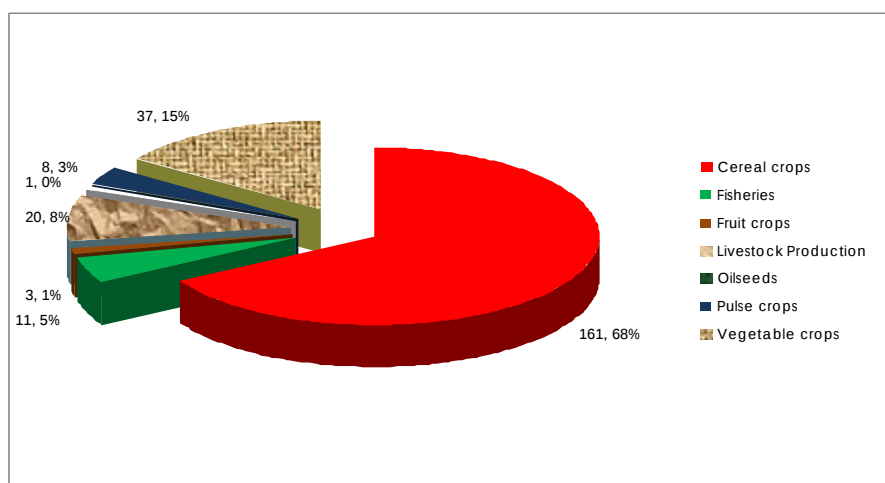
Fig 3. Effect of land holding size on number of livestock in coastal saline zone of West Bengal

Table 4. Per earner per annum farm business income over various farm size categories in different farming systems in coastal saline zone of West Bengal (in Rs)

| Parameter                             | Total            | Marginal                      | Small                          | Medium                         | Large                      | Significance |
|---------------------------------------|------------------|-------------------------------|--------------------------------|--------------------------------|----------------------------|--------------|
| <b>Livestock-based farming system</b> |                  |                               |                                |                                |                            |              |
|                                       | n= 20            | n= 11                         | n= 5                           | n= 2                           | n= 2                       |              |
| Cereals                               | 12340.5 (27.64)  | 7995.22 (27.55)               | 14512.4 (27.69)                | 19666.2 (30.39)                | 23484.1 (25.79)            | NS           |
| Vegetables                            | 1908.72 (4.28)   | 2423.12 (8.35)                | 0 (0)                          | 0 (0)                          | 5760 (6.33)                | NS           |
| Pulses                                | 7893.56 (17.68)  | 3833.12 (13.21)               | 10654.96 (20.33)               | 12128 (18.74)                  | 19088 (20.96)              | NS           |
| Oilseeds                              | 244.27 (0.55)    | 444.12 (1.53)                 | 0 (0)                          | 0 (0)                          | 0 (0)                      | NS           |
| Fishery                               | 5105.25 (11.44)  | 1754.55 (6.05)                | 6520 (12.45)                   | 8162.5 (12.61)                 | 16940 (18.6)               | NS           |
| <b>Livestock</b>                      |                  |                               |                                |                                |                            |              |
| Dairy                                 | 13535.75 (30.32) | 10637.28 (36.65)              | 13290 (25.36)                  | 21900 (33.84)                  | 21727.5 (23.86)            | NS           |
| Goatry                                | 1680.75 (3.77)   | 941.37 (3.25)                 | 2838 (5.42)                    | 1615 (2.5)                     | 2920 (3.21)                | NS           |
| Poultry                               | 933.75 (2.1)     | 454.55 (1.57)                 | 2735 (5.22)                    | 0 (0)                          | 0 (0)                      | NS           |
| Duckery                               | 1008 (2.26)      | 545.46 (1.88)                 | 1860 (3.55)                    | 1260 (1.95)                    | 1170 (1.29)                | NS           |
| Total                                 | 44650.5282       | 29028.7423                    | 52410.36                       | 64731.7                        | 91089.6                    |              |
| <b>Cereal-based farming system</b>    |                  |                               |                                |                                |                            |              |
|                                       | n= 161           | n= 53                         | n= 74                          | n= 29                          | n= 5                       |              |
| Cereals                               | 26775.31 (54.4)  | 12890.48 (53.95)              | 25547.19 (48.27)               | 42801.79 (57.57)               | 70080.81 (59.82)           | NS           |
| Vegetables                            | 4374.6 (8.89)    | 2721.23 (11.39)               | 4588.24 (8.67)                 | 7387.97 (9.94)                 | 17588.38 (15.02)           | NS           |
| Pulses                                | 6797.19 (13.81)  | 2301.24 (9.64)                | 8495.8 (16.05)                 | 9384.36 (12.63)                | 14309.35 (12.22)           | NS           |
| Oilseeds                              | 1323.1 (2.69)    | 1008.74 (4.23)                | 1442.31 (2.73)                 | 1455.67 (1.96)                 | 2122.27 (1.82)             | NS           |
| Fishery                               | 4026.46 (8.18)   | 2208.97 (9.25)                | 4426.83 (8.37)                 | 6022.42 (8.1)                  | 5790 (4.95)                | NS           |
| <b>Livestock</b>                      |                  |                               |                                |                                |                            |              |
| Dairy                                 | 4663.93 (9.48)   | 3187.27 (13.34)               | 5215.98 (9.86)                 | 5675.69 (7.64)                 | 6278 (5.36)                | NS           |
| Goatery                               | 344.48 (0.7)     | 64.53 (0.28)                  | 538.86 (1.02)                  | 316.04 (0.43)                  | 600 (0.52)                 | NS           |
| Poultry                               | 401.19 (0.82)    | 384.91 (1.62)                 | 376.49 (0.72)                  | 563.11 (0.76)                  | 0 (0)                      | NS           |
| Duckery                               | 276.55 (0.57)    | 394.34 (1.66)                 | 164.37 (0.32)                  | 326.21 (0.44)                  | 400 (0.35)                 | NS           |
| Total                                 | 49227.17         | 23893.99                      | 52933.6                        | 74353.9                        | 117168.78                  |              |
| <b>Vegetable-based farming system</b> |                  |                               |                                |                                |                            |              |
|                                       | n= 37            | n= 15                         | n= 14                          | n= 6                           | n= 2                       |              |
| Cereals                               | 21883.83 (24.15) | 7593.27 (14.18 <sup>a</sup> ) | 24072.03 (24.91 <sup>b</sup> ) | 41301.02 (28.61 <sup>c</sup> ) | 55494 (33.6 <sup>c</sup> ) | **           |

|                  |                  |                               |                                |                                 |                                |    |
|------------------|------------------|-------------------------------|--------------------------------|---------------------------------|--------------------------------|----|
| Vegetables       | 44815.08 (49.45) | 31759.31 (59.28)              | 46211.66 (47.81)               | 66518.67 (46.08)                | 67846.56 (41.08)               | NS |
| Pulses           | 8849.63 (9.77)   | 1479.13 (2.77 <sup>a</sup> )  | 12309.11 (12.74 <sup>b</sup> ) | 16963.69 (11.75 <sup>b</sup> )  | 15569.95 (9.43 <sup>b</sup> )  | ** |
| Oilseeds         | 782.15 (0.87)    | 475.92 (0.89 <sup>a</sup> )   | 0 (0)                          | 1085 (0.76 <sup>a</sup> )       | 7645.32 (4.63 <sup>b</sup> )   | ** |
| Fishery          | 7832.44 (8.65)   | 4796.67 (8.96)                | 8132.15 (8.42)                 | 14341.67 (9.94)                 | 8975 (5.44)                    | NS |
| Livestock        |                  |                               |                                |                                 |                                |    |
| Dairy            | 4511.36 (4.98)   | 6012 (11.23)                  | 3810.77 (3.95)                 | 3750 (2.6)                      | 2350 (1.43)                    | NS |
| Goatery          | 963.25 (1.07)    | 0 (0 <sup>a</sup> )           | 1481.43 (1.54 <sup>ab</sup> )  | 416.67 (0.29 <sup>a</sup> )     | 6200 (3.76 <sup>b</sup> )      | *  |
| Poultry          | 236.36 (0.27)    | 583 (1.09)                    | 0 (0)                          | 0 (0)                           | 0 (0)                          | NS |
| Duckery          | 330.82 (0.37)    | 576 (1.08)                    | 102.86 (0.11)                  | 0 (0)                           | 1080 (0.66)                    | NS |
| Total            | 90638.64         | 53578.6                       | 96669.21                       | 144376.7                        | 165160.8                       |    |
| <b>Overall</b>   |                  |                               |                                |                                 |                                |    |
|                  | n= 240           | n= 89                         | n= 101                         | n= 40                           | n= 10                          |    |
| Cereals          | 23734.65 (42.58) | 11031.62 (35.86)              | 25237.42 (42.62)               | 40903.44 (47.06)                | 52938.43 (44.73)               | NS |
| Vegetables       | 10212.19 (18.32) | 6732.31 (21.89)               | 9814.38 (16.58)                | 15524.76 (17.87)                | 23950.7 (20.24)                | NS |
| Pulses           | 7563.14 (13.57)  | 2560.88 (8.33 <sup>a</sup> )  | 9453.48 (15.97 <sup>b</sup> )  | 11674.11 (13.44 <sup>ab</sup> ) | 16547.06 (13.98 <sup>b</sup> ) | ** |
| Oilseeds         | 1256.5 (2.26)    | 909.46 (2.96)                 | 1362.5 (2.31)                  | 1427.59 (1.65)                  | 2590.2 (2.19)                  | NS |
| Fishery          | 5557.57 (9.97)   | 3567.42 (11.6)                | 6170.9 (10.42)                 | 7375.63 (8.49)                  | 9803 (8.29)                    | NS |
| <b>Livestock</b> |                  |                               |                                |                                 |                                |    |
| Dairy            | 338.02 (0.61)    | 4531.07 (14.73 <sup>b</sup> ) | 5315.22 (8.98 <sup>ab</sup> )  | 6035.93 (6.95 <sup>a</sup> )    | 9764.5 (8.25 <sup>ab</sup> )   | ** |
| Goatery          | 519.65 (0.94)    | 154.78 (0.51)                 | 740.65 (1.26)                  | 372.38 (0.43)                   | 2124 (1.8)                     | NS |
| Poultry          | 412.78 (0.75)    | 449.44 (1.47 <sup>b</sup> )   | 423.12 (0.72 <sup>a</sup> )    | 408.25 (0.47 <sup>a</sup> )     | 0 (0)                          | *  |
| Duckery          | 338.02 (0.61)    | 419.56 (1.37)                 | 250.53 (0.43)                  | 299.5 (0.35)                    | 650 (0.55)                     | NS |
| Total            | 55752.62         | 30764.35                      | 59228.82                       | 86920.3                         | 118367.9                       |    |

Figures in parentheses are per cent values, a, b, c, d= Similar alphabets denote homogenous share, Data analysed by Duncan's test



**Fig 4. Number of farmers under different farming systems in coastal saline zone of West Bengal**

The share of income from dairy and poultry was significantly greater for marginal farmers compared to large farmers unlike in goatery. This contradicts the earlier finding that number of livestock (especially goats) increased with size of land holding. The obvious reason for this could be that there was dependency of marginal farmers on livestock enterprise for family income leading to greater care and management and thus greater return. However regarding pulses there was significant increase in share of total income from marginal to large farmers that was consistent with greater share of land allocation towards pulses by large farmers.

In vegetable-based farming system the share of income from cereals, pulses and oilseeds was significantly greater for large farmers compared to marginal farmers.

Besides the share of income from goatery was also greater in case of large farmers than other groups. This indicates that farmers of this category had not only utilized their land efficiently than others through crop rotation but also they had been successful in integrating farm by-products with livestock enterprises.

## CONCLUSION

The study reveals that in coastal saline zone of West Bengal as the size of land holding increased crop diversification decreased with increase in the number of livestock and greater allocation of land towards pulses. Among livestock the rearing of black Bengal goats was very popular in this part and the number increased with increase in the size of land holding. Livestock constituted 18.08 per cent of farm income

for marginal farmers while its share was only 8 per cent for large farmers. This indicates that livestock enterprise was a subsidiary enterprise with tremendous potential for further growth.

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*Received: 4.4.2015*

*Accepted: 24.11.2015*