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Economic Analysis of Major Farming Systems in Hyderabad-Karnataka

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study was undertaken in Hyderabad-Karnataka state to assess cost and returns under major farming systems, net income of the farmers from different sources and significant influence of area and dairy in major farming systems. Four major farming systems *viz.,* Crop+Dairy (C+D), Crop+Horticulture (C+H), Horticulture+Dairy (H+D) and Crop+Dairy+Horticulture (C+H+D) were identified based on the preliminary surveys in the area. The study is based on primary data of 160 farmers covering equal samples under major farming systems elicited through the survey for 2016-17. The data were analyzed using descriptive statistics and Gini coefficient. Results revealed that net annual income realized by farm household was higher in Crop+Dairy+Horticulture (Rs. 8,62,897.70) farming system of which 72.42 per cent was from horticulture. The least annual net income was observed in Crop+Dairy (Rs. 2,17,982.21) farming system of which 55.49 per cent was from livestock enterprise. The inequality was relatively lower in Crop+Dairy (0.45) farm households. The inequality was more in Crop+Dairy+Horticulture (0.53) farm households.

Keywords: Farming systems; income; livestock; inequality.

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1. INTRODUCTION

Indian agriculture is known for its multi-functionalities of providing employment, livelihood, food, nutrient and ecological securities. Agriculture and allied activities contribute about 18 per cent to the gross domestic product and the growth rate of agriculture is around 4.5 per cent (2016-17). Indian agriculture employs 50 per cent of the total workforce and it is the major source of poverty alleviation, empowerment of the agrarian folk and it is the cornerstone of development for India. As a result of sustained efforts, food grain production has increased from 50.8 million tonnes in 1950-51 to 272 million tonnes in 2016-2017 [1].

Traditional farming system used by farmers in India are based on centuries of experiences characterized by mixed farming involving crop production with one or more enterprises like dairy, poultry, sericulture, piggery, sheep, goat, fisheries bee-keeping *etc.*, with a aim to achieve stability of production, provide subsistence for the family and guard against weather aberration and other environmental stresses. In recent days, farming system approach gave the scientific touch to the existing practices and found ways and means to make it sustainable in changing global scenario. At an aggregate level, it is appropriate to study the farming system in relatively homogeneous agro-climatic regions in keeping with natural endowments and factors, which are normally not subject to change.

To understand the livelihood security of households under different farming systems, there is a need to study socio-economic characters, income and expenditure pattern of different farming systems. In this direction, the study was undertaken with the objective to identify and estimate the relative economics of major farming systems practised in Hyderabad-Karnataka.

1.1 Scope of the Study

There are various types of farming systems in Hyderabad-Karnataka. Till now, no comprehensive study has been made to know the livelihood security of farm households and economic appraisal of the various farming systems in Hyderabad-Karnataka in general and Ballari and Koppal districts in particular. Hence, Ballari and Koppal districts are purposively selected for the study. The findings of the study would throw light on the process of modernization of agriculture. This will help the planners and policy makers in formulating policy package and plan of action for increasing and stabilizing farm income of individual farmers which ultimately able to provide livelihood security.

2. METHODOLOGY

2.1 Sampling Procedure Adopted

Three staged purposive cum random sampling was adopted in the present study, where at primary level purposively Ballari and Koppal districts were selected based on high practice in different farming systems. A list of villages in Ballari and Koppal districts was collected from the district statistical office. From this list, eight villages from each district were selected randomly. From each selected village, 10 farmers were randomly selected who are practising farming systems like C+D (Crop+Dairy), C+H (Crop+Horticulture), H+D (Horticulture+Dairy) and C+D+H (Crop+Dairy+Horticulture) farming systems. Thus, the total sample for the study was 160 farm households.

2.2 Nature and Source of Data

In order to evaluate the objectives of the study, data were collected from both primary and secondary sources.

Primary data: The four major farming systems identified in the study were Crop+Dairy, Crop+Horticulture, Horticulture+Dairy and Crop+Dairy+Horticulture. The primary data required for the study were collected from the randomly selected farm households on the socio-economic characteristics, land holdings, inventory of implements and machinery, cost and returns of principal crops through personal interview using pre-tested structured schedule.

Secondary data: The data regarding cropping pattern, land utilization and general information of district were collected from district statistical office of Ballari and Koppal districts.

2.3 Analytical Tools and Techniques Employed

To fulfil the specific objectives of the study, data collected were subjected to the following analyses.

1. Tabular presentation with averages, ratios and percentages
2. Gini co-efficient analysis

2.3.1 Tabular presentation

A Tabular method was adopted to compile the general characteristics of the sample farmers, determine the resource structure, cost structure, returns, profits and total benefits that the farmer received *etc.* A simple statistical tool like averages, ratios and percentages were computed to interpret results properly.

2.3.1.1 Amortization of benefits availed from perennial crops

The concept of amortization was used in the calculation of cost and return of farm households in pomegranate, fig and mango. Pomegranate and mango being perennial crops, costs were worked out separately as establishment and maintenance costs. For working out establishment cost, inputs along with associated cost during the first three years of the plantation were considered. During the establishment period, costs were broadly classified into variable and fixed costs, variable costs included material input and labour costs. The fixed costs included rental value of land, land revenue, depreciation and interest on fixed costs. For arriving at maintenance costs, costs incurred on material inputs and labour were used.

$$A = P\frac{r(1+r)^n}{(1+r)^n - 1}$$

Where,

A = Amortized benefit per year from particular crop.
P = Total initial benefit received by the farmer.
r = Interest rate per year, r is taken as 2 %
n = Total number of years of benefits flow, n is taken as the total number of years for each crop

2.3.1.2 Economics of crop production

To study the economics of principal crops, averages and percentages were used. Different concepts of costs and returns used in the study are presented in this section. In the present study, all calculations pertaining to the economics of principal crops were made on per hectare basis.

Input and cost concepts:

The total costs were divided into three broad categories:

a. Variable Costs
b. Fixed Costs
c. Marketing Costs
d. Cost of cultivation (a+b)
e. Total cost (c+d)

a. Variable costs: The variable costs include costs of seeds, manure, fertilizers, wages of human, machine and bullock labour, plant protection chemicals, irrigation, *etc.,* and interest on operational capital and repair and maintenance charges.

i. Seedlings: The cost of purchased seedlings was based on the actual amount paid by the farmers.
ii. Farmyard manure: The prevailing price per tonne was used to impute the value of farmyard manure produced on the farm.
iii. Fertilizers and plant protection chemicals: The cost of fertilizers and plant protection chemicals was based on the actual prices paid by the farmers including the cost of transportation and other incidental the charges, if any.
iv. Labour: The cost of hired labour was calculated at the prevailing wage rates paid per day (8 hours) in the study area for Men, Women and Bullock pair and Machine labour during the study period. The cost of family labour (human, animal and machinery) was calculated considering the prevailing market rate in this region through imputation.
v. Irrigation cost: The irrigation cost on acre basis is worked as follows;

$$\text{Cost per acre inch of water} = \frac{\text{Total amortized cost of irrigation}}{\text{Total number of acre inches of water required}}$$

The number of acre inches of groundwater extracted for each crop in each season = frequency of the irrigation per month * Number of months of crop * Number of hours to irrigate the crop area* average yield of bore well in Gallon per hour (GPH) / 22611. The amortized cost of irrigation is equal to the amortized cost of irrigation well + Amortization cost of convenience + Amortization cost of pump set and accessories + Amortization cost of repair and maintenance.

Thus, the cost of irrigation for any crop is worked out by multiplying the amortized cost of irrigation with the number of acre inches of water used.

vi. Interest on operational capital: The working capital consists of the expenditure on labour, seedlings, farmyard manure, fertilizers and plant protection chemicals, irrigation and materials. Interest on operational capital was calculated at the rate of seven per cent per annum (the rate at which commercial banks advance short term loans) and was apportioned to the crop based on the duration of the crop.
vii. Repair and maintenance charges: Repair and maintenance charges of implements and machinery used in the cultivation were computed on the basis of actual expenses incurred by the respondents. The amount was apportioned based on usage and acreage.

b. Fixed costs: These include depreciation on farm implements and machinery, interest on fixed capital, land revenue.

The measurement and definitions of fixed cost components are as follows.

i. Depreciation charges: Depreciation on each capital equipment and machinery owned by the farmers and used in crop cultivation was calculated using the straightline method as:

$$\text{Annual depreciation} = \frac{\text{Purchase value (Rs)} - \text{Junk value (Rs)}}{\text{Economic life of the asset (years)}}$$

The average life of the asset as indicated by the experts (Agril. Engineers) was used in the computation of the depreciation. The depreciation cost of each equipment was apportioned to the crop based on its percentage use.

ii. Interest on fixed capital: Interest charges on fixed capital were calculated at the rate of nine per cent, as the fixed deposits in commercial banks would fetch this rate of interest. The items considered under fixed capital are implements and machinery. Interest was considered on the value of these assets after deducting the depreciation for the year.
iii. Land revenue: Actual land revenue paid by the farmers was considered.
iv. Rental value of the land: In the study area, the practice of leasing in and leasing out is absent in many crops. Hence, the rental value of land was not considered in the present study.

c. Marketing costs: The actual marketing charges incurred by the farmers in the marketing of crop produce were considered. These marketing costs include cost of packing, loading and unloading charges, hamali charges, transportation costs, wastage, market cess and miscellaneous charges.

d. Cost of cultivation: It is the sum of variable costs and fixed costs and expressed on per hectare basis.

e. Total cost: Total cost is the sum of the cost of cultivation per hectare and the cost of marketing the produce.

Output and returns: In most of the crops, the output included the main yield of the crop only and in some cases it included by-product also.

Per hectare returns were calculated by using the below-mentioned procedure.

i. Net returns on variable costs: It is the gross returns minus variable costs.
ii. Net returns on the cost of cultivation: It is the gross returns minus variable costs plus fixed costs.
iii. Net returns on total cost: It is the gross returns minus cost of cultivation plus marketing cost.
iv. Returns per rupee of expenditure: Worked out by taking the ratio of net return to total cost

$$\text{Net Return per rupee of cost} = \frac{\text{Net returns}}{\text{Total cost}}$$

2.3.2 Gini co-efficient analysis

The Gini coefficient is a measure of inequality of income distribution. The Gini coefficient ranges from 0 to 1, where 0 corresponds to perfect income equality (*i.e.* everyone has the same income and 1 corresponds to perfect inequality (*i.e.* one person has all the income, while everyone else has zero income).

Gini coefficient is calculated by using the formula:

$$G = 1 + \frac{1}{n} - \frac{1}{n^2 Y} [y_1 + 2y_2 + 3y_3 + \ldots\ldots\ldots\ldots + ny_n]$$

Where,

G = Gini coefficient
n = Sample size
Y = Average Net farm income of farm household

y_1, y_2, y_3 .....y_n are Net farm income of each sample farmer arranged in the ascending order of magnitude of yi. The farmer who is having the lowest net farm income is first, and then next and so on.

3. RESULTS

3.1 Economics of Major Farming Systems

Cost and return structure of principal crops and subsidiary enterprises practised by farm households under major farming systems is worked out and is presented under the following headings.

3.2 Relative Economics of Principal Crops

The relative economics of both annual (paddy, jowar and maize) and perennial (pomegranate, banana, fig and mango) crops on hectare basis is presented in Table 1. Net returns as well as, returns per rupee of investment, were more in Crop+Dairy farms in all principal crops like paddy (Rs. 17,365), jowar (Rs. 9,114.67) and maize (Rs. 5,822) and returns per rupee of investment were 1.39, 1.45 and 1.13, respectively.

In case of Crop+Horticulture farms, Net returns was highest in paddy (Rs. 15,899) followed by jowar (Rs. 11,652.65) and maize (Rs. 8) and returns per rupee of investment were 1.34, 1.50 and 1.00, respectively. In perennial crops, net returns were higher in pomegranate (Rs. 3,89,552.98) followed by fig (Rs. 98,627.40) mango (Rs. 28,850) and banana (Rs. 16,858.25) and returns per rupee of investment were 2.18, 1.33, 1.42 and 1.05, respectively.

In case of Horticulture+Dairy farms, perennial crops *i.e.*, pomegranate, banana, fig and mango, the net returns were higher in pomegranate (Rs. 3,88,923.25) followed by fig (Rs. 1,33,475.95), mango (Rs. 43,987.43) and banana (Rs. 11,226.33) and returns per rupee were 2.16, 1.40, 1.47 and 1.03, respectively.

In case of Crop+Dairy+Horticulture system, the net returns was highest in paddy (Rs. 15,988) followed by jowar (Rs. 12,966.38) and maize (Rs. 5,096) and returns per rupee of investment were 1.34, 1.52 and 1.64, respectively. In perennial crops, the net return was highest in pomegranate (Rs. 3,90,155.95) followed by fig (Rs. 1,42,812.12), banana (Rs. 62,859.20) and mango (Rs. 61,582.40) and returns per rupee were 2.17, 1.42, 1.14 and 1.47, respectively.

3.3 Relative Economics of Subsidiary Enterprises

The economics of major subsidiary enterprises under each farming system is presented in Table 2. Dairy is one of the major subsidiary enterprises practised by Crop+Dairy, Horticulture+Dairy and Crop+Dairy+Horticulture households. The net returns per crossbreed cow was worked out on lactation basis which was maximum in Crop+Dairy (Rs. 86,391.10) farms followed by Horticulture+Dairy (Rs. 58,935.40) farms and Crop+Dairy+Horticulture (Rs. 50,324.70) farms. Similarly, the returns per rupee were 1.31, 1.34 and 1.36, respectively.

3.4 Annual Farm Household Income

The farming system is aimed at the efficient use of resources to maximize the income. It also minimizes the production risk by spreading the

risk to the various enterprises instead of one activity. The details of the annual income of households derived from the major farming system are furnished in Table 3. The Crop+Dairy+Horticulture (Rs. 8,62,897.70) households realized a maximum annual income of which 77.10 per cent was from horticulture enterprise followed by Horticulture+Dairy (Rs. 7,87,578.44) system of which 74.08 per cent was from horticulture enterprise, 18.71 per cent from dairy enterprise and 7.21 per cent from non-farm. With respect to Crop+Horticulture farm households the annual income was Rs. 5,90,946.38 and 90.08 per cent of total annual income was sourced from horticulture enterprise and 5.25 per cent from non-farm. Crop+Dairy farm households have realized least annual income of Rs. 2,17,982.21 of which 55.49 per cent was from the dairy enterprise, 29.70 per cent from non-farm activities and only 14.82 per cent from crops.

Table 1. Relative economics of principal crops under major farming systems (Rs. / ha)

Sl. no.	Farming systems	Crop	Gross returns	Total cost	Net returns	Returns per rupee of expenditure
I.	C+D	Paddy	62,111.00	44,746.00	17,365.00	1.39
		Jowar	29,369.84	20,255.17	9,114.67	1.45
		Maize	50,622.00	44,800.00	5,822.00	1.13
II.	C+H	Paddy	63,122.00	47,223.00	15,899.00	1.34
		Jowar	34,747.58	23,094.93	11,652.65	1.50
		Maize	41,478.00	41,470.00	8.00	1.00
		Pomegranate	7,18,950.54	3,29,397.56	3,89,552.98	2.18
		Banana	3,77,710.00	3,60,851.75	16,858.25	1.05
		Fig	3,99,000.00	3,00,372.60	98,627.40	1.33
		Mango	68,825.00	97,675.00	28,850.00	1.42
III.	H+D	Pomegranate	7,23,553.38	3,34,630.13	3,88,923.25	2.16
		Banana	4,08,163.25	3,96,936.93	11,226.33	1.03
		Fig	4,65,393.60	3,31,917.65	1,33,475.95	1.40
		Mango	92,757.57	136745.00	43,987.43	1.47
IV.	C+D+H	Paddy	62,360.00	46,372.00	15,988.00	1.34
		Jowar	37,985.89	25,019.51	12,966.38	1.52
		Maize	13,469.00	8,373.00	5,096.00	1.64
		Pomegranate	7,22,804.63	3,32,648.68	3,90,155.95	2.17
		Banana	5,07,428.55	4,44,569.36	62,859.20	1.14
		Fig	4,82,790.00	339977.88	142812.12	1.42
		Mango	1,29,860.60	191443.00	61582.40	1.47

Note: C+D: Crop+Dairy; C+H: Crop+Horticulture; H+D: Horticulture+Dairy and C+D+H: Crop+Dairy+Horticulture

Table 2. Relative economics of subsidiary enterprises under major farming systems (in Rupees)

Sl. no.	Farming Systems	Crops	Gross returns	Total cost	Net returns	Returns per rupee of expenditure
I.	C+D	Dairy (per crossbreed cow per Lactation)	365727.30	279336.20	86391.10	1.31
II.	H+D	Dairy (per crossbreed cow per Lactation)	230576.00	171640.60	58935.40	1.34
III.	C+D+H	Dairy (per crossbreed cow per Lactation)	189070.00	138745.30	50324.70	1.36

Note: C+D: Crop+Dairy; C+H: Crop+Horticulture; H+D: Horticulture+Dairy and C+D+H: Crop+Dairy+Horticulture

Table 3. Annual farm household net income of major farming systems from various sources (Rs./annum)

Sl. no.	Farming systems	Crops	Livestock	Horticulture	Non-farm income*	Total
I.	C+D	32,301.67 (14.82)	1,20,947.54 (55.49)	-	64,733.00 (29.70)	2,17,982.21 (100)
II.	C+H	27,559.65 (4.66)	-	5,32,353.73 (90.08)	31,033.00 (5.25)	5,90,946.38 (100)
III.	H+D	-	1,47,338.50 (18.71)	5,83,469.94 (74.08)	56,770.00 (7.21)	7,87,578.44(100)
IV.	C+D+H	34,050.38 (3.95)	1,25,811.75 (14.58)	6,65,285.57 (77.10)	37,750.00 (4.37)	8,62,897.70(100)
	All FS	23,477.93 (3.82)	98,524.45 (16.02)	4,45,277.31 (72.42)	47,571.50 (7.74)	6,14,851.18 (100.00)

Note: Figures in parentheses represent percentages to total
**Non-farm income includes income earned by working in others field for wages, working in Governmental organizations, working in private organizations or through own enterprises like kirana shops etc.*
C+D: Crop+Dairy; C+H: Crop+Horticulture; H+D: Horticulture+Dairy
C+D+H: Crop+Dairy+Horticulture; FS: Farming System

Table 4. Gini coefficient for the distribution of annual income among farm households in major farming systems

Sl. no.	Farming systems	Gini coefficient
1	C+D	0.45
2	C+H	0.46
3	H+D	0.51
4	C+D+H	0.53

Note: C+D: Crop+Dairy; C+H: Crop+Horticulture; H+D: Horticulture+Dairy and C+D+H: Crop+Dairy+Horticulture

3.5 Distribution of Annual Income among Farm Households

Here in Table 4. Zero correspond to perfect equality in the distribution of income (*i.e.* everyone has the same income) and one corresponds to perfect inequality in the distribution of income. Considering the inequality in the distribution of benefits as indicated by Gini coefficients, the inequality was relatively lower in Crop+Dairy (0.45) farm households. The inequality was more in Crop+Dairy+Horticulture (0.53) farm households.

4. DISCUSSION

4.1 Relative Economics of Principal Crops

Paddy, jowar and maize are the annual crops which are more predominant in farming systems like Crop+Dairy, Crop+Horticulture and Crop+Dairy+Horticulture where irrigation facility is available. Paddy was the dominant crop grown by all households of three farming systems (Crop+Dairy, Crop+Horticulture and Crop+Dairy+Horticulture). In case of perennials, banana and pomegranate have been cultivated by the majority of farm households. In order to see the variation in the cost and returns across farming systems, cost and return structure for these principal crops were worked out.

Although a net return of paddy was very less in all farming systems (Table 1), it has been cultivated every year for the sake of food grains as it is one of the staple food grains of this region beside it also provides nutritious fodder (straw) to livestock. The return per rupee of investment was more in case of Crop+Dairy farm households since the total cost of cultivation was less than others. The reason behind the low cost of cultivation was less application of FYM and less use of machine power by Crop+Dairy farm households. Returns from paddy in case of Crop+Dairy system was more than Crop+Horticulture and Crop+Dairy+Horticulture since the higher usage of human labour and the depreciation value of fixed assets was also high. There was no much variation in the returns per rupee of investment in jowar crop among farming systems and in case of maize the returns per rupee of investment as very less but mainly grown for fodder purpose. In case of pomegranate, the return per rupee of investment was more in all three farming systems in remaining horticultural crops (banana, fig and

mango) the returns per rupee of investment was more and low maintenance cost attributed to the higher net returns per rupee of investment in all horticultural combination of the farming system. Similar kind of result obtained by Singh et al. [2] the rice-wheat cropping pattern is likely to produce the highest and more stable income.

4.2 Relative Economics of Subsidiary Enterprises

Dairy is one of the important components in Crop+Dairy, Horticulture+Dairy and Crop+Dairy+Horticulture farming systems. A major part of the total costs in the dairy enterprise was covered by feed concentrates in both farming systems. The lower net returns in Crop+Dairy+Horticulture (Rs 50,324.70) per crossbred cow per lactation was due to higher cost of labour (Table 2). Only variable cost was considered for analysis, since the fixed cost was heritable in nature from year to year and also there was not much fixed capital involved. The cost increased in cow-rearing was maximum on feed and fodder followed by veterinary care. All the households were using owned human labour in cow rearing so the cost of hired labour was not accounted for.

The findings of the present study are in line with that of previous studies of Singh and Joshi [3] wherein expenditure on concentrates and labour accounted more in total cost structure of dairy farming in different zones of Punjab across different size group of households. Similarly, Suresh et al. [4] has reported that the expenditure on feed and fodder followed by veterinary care accounted more in total cost structure of sheep rearing across different size group of households in semi-arid regions of Rajasthan.

4.3 Annual Income of Farm Household

Farming system is aimed at efficient use of resources to maximize the income. It also minimizes the production risk by spreading the risk to the various enterprises instead of one activity. The details of annual farm household income among major farming system derived from various sources indicated that (Table 3), the Crop+Dairy+Horticulture farmers realized a maximum net annual income of Rs 8,62,897.70 of which 77.08 per cent was sourced back from horticulture and remaining from crops, dairy and non-farm enterprise. Due to maximum area under irrigation in this farming system the farmers could able to plant more land with horticulture crops and also able to cultivate paddy, maize and jowar crop. Due to the availability of green fodder throughout the year the farmers could able to rear cow. As a result the net annual income was more in Crop+Dairy+Horticulture farms. The net annual income realized by the Crop+Dairy farm households was very low (Rs 2,17,982.21) as their livelihood is mainly dependent on livestock income, 55.49 per cent of their annual income was from livestock and 29.70 per cent of their annual income was from non-farm activities like working in others field, business *etc*. The findings of the present study are contrary to that of Kandasamy [5] where he reported that, dairy-based farming system gave the highest annual income (Rs 6,090/ha) with a per day income of Rs 16.16 and provided additional employment of 217 man days per year as against Rs 1,902 and Rs 5.21 net annual income and per day income, respectively, with farmer's method of sole cropping. Kumar et al. [6] studied interactions and changes in farming systems in semi-arid parts of India. There were wide variations in the source and magnitude of household income among the identified farming systems. However the farming system comprising of crop and livestock contributed a major share accounting for more than 80 per cent of the total family income in all the farming systems.

4.4 Distribution of Annual Income among Farm Households

The results of Gini coefficient analysis (Table 4) showed that with the inclusion of wage income there was an inequality among the sample households in Crop+ Dairy+Horticulture farming system. The main reason behind the relative inequality Crop+ Dairy+Horticulture farm households and other three farming system households was due to their dependence on wage employment in agriculture field as a labour which provides employment almost the year round. Unlike the households of Crop+Dairy+Horticulture, other farmers enjoy the steady flow of income from agriculture and other subsidiary activities mainly due to availability of irrigation facility.

5. CONCLUSION

The farming system has provided effective recycling of produce of one component as input

on the other component/s. It also provided the flow of cash to the farmers round the year by way of disposal of milk, meat, eggs and fruits. The dairy and the horticulture components contributed the higher proportion to the total income in the existing farming systems. Dairy and horticulture enterprise are complementary to each other and found to sustain farm income. Cropping pattern of most of the farmers aimed at meeting their food grain needs and fodder requirement of livestock through their own farm production. Farmers generally choose one or two enterprises as their principal or main enterprise around which they develop their farming system – an enterprise that has high and sustained marginal returns.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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