INCOME AND EMPLOYMENT POTENTIAL OF DAIRY, CROP AND MIXED FARMING SYSTEMS ON SMALL FARMS

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SUMMARY

An attempt has been made in this paper to assess the income and employment potential of different farming systems on small farms in rural areas and to compare the figures with those from dairy demonstration units (DDU) and on-farm trials. The study shows that mixed farming systems on the DDU's generated higher income and human labour employment than on small farms. Further, dairy farming sub-systems provided more employment than crop farming sub-systems, both on demonstration units and on small farms. Thus, the inclusion of a dairy component into mixed crop farming systems has the potential to provide gainful employment for rural smallholders. Therefore, optimum farm plans for different resource situations need to be developed, for subsequent popularization by the extension services and development agencies.

INTRODUCTION

Recently, the focus of rural development has shifted towards small farms which constitute a large majority of farm units in developing countries. Technological advances in Indian agriculture have led to increased total production in the country, but various agricultural development programs have overlooked the small farms with holding of less than 2 hectares which comprise nearly 76 per cent of the total operational holdings in India (Government of India, 1991).

Because farming systems change over time and location in response to technological, economic, social and political forces (Simpson, 1988), there is a wide range of farming systems in almost every country of the world and the same is true for India (Jain and Dhaka, 1993). Examples of such variation are elaborated by Singh and Patil (1993) and Vijayalakshmi *et al.* (1993). In high potential areas like the Karnal district of Haryana state, buffalo and cattle farming is an important sub-system of the mixed farming system where crop farming dominates. There is ample evidence to suggest that a large proportion of the animals are owned by small farmers. Animals provide milk, dung for farm yard manure and fuel, traction, transport, skins and hides, insurance and investment along with progeny. Thus, the small holder meets the multi purpose requirements of family and farm by keeping animals (Singh *et al.*, 1981; Sharma and Singh, 1984; Berleant and Schiller, 1977).

Unemployment and under-employment are cause and result of poverty in India. Employment has never received a high priority in consecutive Five Year Plans though the agricultural sector can absorb a part of the growing labour force if more productive and

efficient use of limited land and capital is made through improved farming systems and practices.

The problems of unemployment and under-employment lead to low income and investment on small farms. The problems of (under)employment vary between seasons (peak labour requirement), gender groups and between agro-economic zones. Vijayalakshmi *et al.* (1993) hypothesize that in the villages around Karnal the labour is relatively scarce compared with systems in Gujarat and around Bangalore (Karnataka). It is essential to develop, introduce and test technically feasible, economically viable, socially acceptable and sustainable farming systems and relevant technologies for small holders to increase farm income and productivity of labour (Amir and Knipscheer, 1989). This paper discusses the economics of dairy, crop and mixed farming systems on small farms in rural areas, comparing these with the results of dairy demonstration units (DDU) in on-station research trials at NDRI, Karnal.

MATERIALS AND METHODS

Data for the year 1989-1990, pertaining to cross-bred cattle and buffalo farming systems were collected from the official records of DDUs of Krishi Vigyan Kendra (KVK) at the National Dairy Research Institute, Karnal. These units test the combination of different proven techniques in farming systems and serve as a demonstration for small farmers (NDRI, 1978). Two systems are compared : one with three cross-bred cows and one with three buffaloes, using one acre for each unit. The units are managed by one permanent labourer each. The variable cost of producing fodder, excluding human labour, on one acre has been taken as the green fodder input in milk production in dairy units. The capital investment and various fixed costs of DDUs have been updated, keeping in view the prevailing prices of various assets. Data for crop production were compared using on-farm crop research trials conducted on farms in the Operational Research Project (ORP) villages adopted by the Institute (Patel *et al.*, 1988). Data on mixed farming systems for the year 1989-1990 were collected from 40 randomly selected small farms in ORP villages. These sampled farms were not participating in on-farm trials. They had an average operational holding of 1.2 ha; ranging from 0.1-2 ha. The prices prevailing in rural areas of various inputs and outputs and wage rates for a permanent labour along with standard farm management concepts have been used to work out various costs and returns. Family labour income has been worked out by adding imputed value of family labour used to net income.

RESULTS AND DISCUSSION

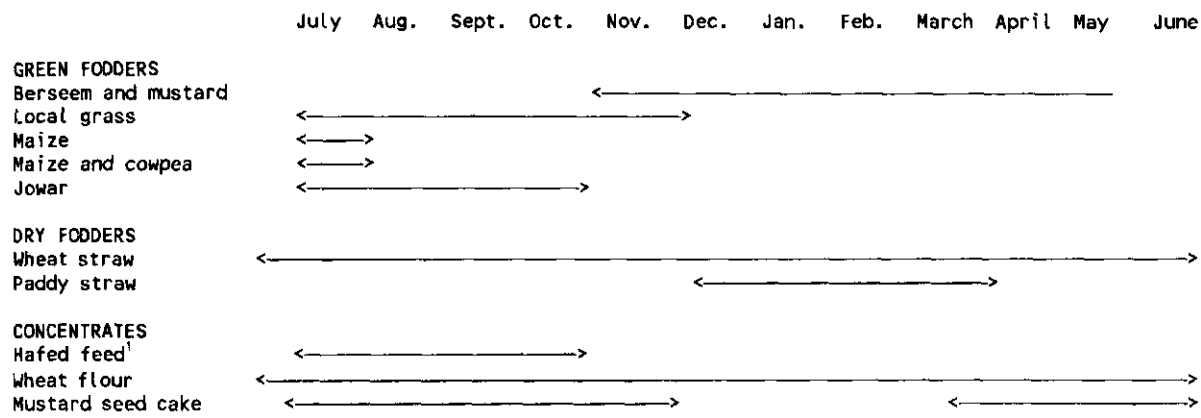
The ORP on integrated milk and crop production, launched by the NDRI in 1975, has followed an approach which is very similar to what is now termed as Farming Systems Research/Extension or

Development (Simmonds, 1986; Patel *et al.*, 1993). Efforts have been made in the project to evaluate research and development results in terms of whole farming systems as perceived by Shaner *et al.* (1982). The economic impact of various technological interventions in dairy and crop farming on productivity, employment and income has been assessed, on sampled farms in the project area.

Dairy Farming Systems of the green revolution belt

The Karnal district of Haryana is part of the green revolution belt that extends from Punjab via Haryana into Western Uttar Pradesh. Most buffaloes and cows in this district are of non-descript type. Buffaloes are reared by farmers for milk production and cows produce cross-breds for sale even to distant states as Bihar, Orissa, Gujarat and Maharastra, as well as for milk production, partly depending on the socio- economic category that keeps the animals. Cows also produce bullocks for traction and transport. By and large, a subsistence level of dairy system is practised by small holders. Small farmers keep 2-3 milch animals of low genetic production potential which are maintained mainly on crop residues. Paddy in kharif (rainy) season and wheat in rabi (winter) season are the most important cereal crops grown in the area which occupy about 71 and 75% of total cropped area on small farms in the respective seasons whose by-products, i.e. straws are fed to the animals. Wheat straw is a more common dry fodder and only in scarcity conditions paddy straw is fed as well. After cereal crops, fodder crops such as maize, sorghum, berseem, oats, etc. occupy the second position in the cropping pattern. These green fodders are chaffed and mixed with dry fodder for feeding to the animals. In addition, small quantities of concentrates in the form of wheat grain or home made mixture of grains and cakes are also fed (Some farmers also buy complete concentrate feed available in the market). An approximate feeding calendar for buffaloes is presented in Figure 1.

Figure 1 Feeding calender for buffaloes on small farms.



[1] a brand name for a commercial concentrate mixture.

Cross-breeding of local cattle with pure Holstein Friesian and upgrading of buffaloes with pure Murrah is done through artificial insemination to improve the genetic potential. With the introduction of cross-bred cows and new forage crops in the dairy sub-system, local cows are being replaced and new farming systems have emerged because farmers in the ORP area have found cross-bred cows more profitable than local cows. In view of the large number of alternatives available to the small farm households, farmers have to make complex decisions about the selection of profitable enterprises and allocation of scarce resources in highly variable recommendation domains (Hildebrand, 1981; Sharma and Singh, 1986).

Economic Analysis of Dairy Farming Systems

Although it is difficult to model complex farming systems due to large variations in feeding and management practices, economic analyses such as a simplified budgeting technique has been used for comparing cross-bred and buffalo farming sub-systems in order to provide information to the policy makers, planners, scientists, extension personnel and the farmers. Economic analysis of cross-bred and buffalo farming sub-systems was carried out and results are presented in Table 1.

Total capital investment of INR 35000 and INR 3800 was made on three cross-bred cow and three buffalo demonstration units, respectively, with each unit controlling one acre of irrigated land where intensive fodder crop rotations are followed to provide sufficient green fodder to the three animals. Further, the calves are weaned away on these units though this is not common practice on rural farms. If a three plot system of fodder production is followed, it can meet the green fodder and crude protein requirements of four adult milch animals in almost all the months of the year except in November (Singh, 1987).

The total variable cost of production was higher for cross-bred cows than for buffaloes due to higher cost of green fodder inputs, concentrates and veterinary aid (Table 1). Feed was the major component of cost of milk production accounting for about 43 and 41 per cent of the gross cost for cross-bred cows and buffaloes respectively while total variable cost of production was accounting for about 66% and 62% of the gross cost respectively.

However, various researchers in the country have observed different proportions of feed cost in the gross cost of milk production for different types of milch animals (Bagi, 1985; Kumar, 1986; Kumar *et al.* , 1984; Patel *et al.*, 1981; Patel *et al.*, 1983; Sharma and Singh, 1985; Singh *et al.*, 1979; Singh, 1991). Feed cost ranged from 43% of gross cost for non-descript local cows in Jammu and Kashmir state (Singh, 1991) to 62% in Uttar Pradesh (Kumar, 1986). In case of buffaloes, feed cost accounted for about 39% in Maharashtra (Bagi, 1985) and 66% in

Andhra Pradesh (Patel *et al.*, 1981). However, for cross-bred cows, it varied between about 44% in Jammu and Kashmir (Singh, 1991) and 73% in Uttar Pradesh (Kumar, 1986). This large variation in the share of feed cost in gross cost could be attributed to the difference in cropping and feeding systems, prices of feed inputs and breeds of animals etc.

Table 1 Breakdown of cost and income of milch animals on specialized dairy demonstration farms on one acre each.

Items	3 cross-bred cow unit		3 buffalo unit	
	INR/yr	% of total	INR/yr	% of total
VARIABLE COST				
Green fodder input	3272	11	2951	10
Dry fodder	181	1	302	1
Concentrates	9013	31	8457	30
Veterinary, water electricity etc.	1847	6	724	3
Human labour	5000	17	5000	18
Total variable cost	19313	66	17434	62
FIXED COST				
Land rent	2000	7	2000	7
Depreciation and interest on fixed capital	7675	26	9040	32
Total fixed cost	9675	33	11040	39
Gross cost	28988	100	28474	100
RETURNS				
Milk production (l/yr/herd)	10393		7565	
Gross return	33259		31773	
Gross margin from milk only	13946[1]		14339[2]	
Net return from the unit	4271		3299	
Net return per cow/buffalo	1424		1100	
Family labour income from the unit	9271		8299	
Family labour income per cow/buffalo	3090		2766	

[1] 3.2 INR/liter; [2] 4.2 INR/liter

The net return per cross-bred cow per annum was approx INR 1424 as against INR 1100 from a buffalo. The relatively higher net return from cross-bred cows could be attributed to lower fixed cost in spite of a higher feed bill. Family labour income per milch animal per annum was INR 3090 and INR 2766 from cross-bred farming and buffalo farming sub-system respectively. This suggests that a cross-bred cattle farm could be superior to buffalo farming system, with larger scope to increase income and labour opportunity for the unemployed and under-employed small farmers.

Economics of milk production from different species of milch animals, viz. cross-bred cow, buffalo and local cow reared by small farmers in the adopted ORP villages show a different result in terms of inputs and output based on the random sample of 40 farmers (see Table 2). Total variable cost of production for a cross-bred cow and a buffalo on small farms sampled in the ORP area was about half that on Dairy Demonstration Units. In absolute terms, cross-bred cows recorded the highest total

variable cost of production (INR 3382) followed by buffaloes (INR 3123) and local cows (INR 2316) accounting for 66, 65 and 69% of the gross production cost respectively. The higher cost of milk production for cross-bred cows could be ascribed to higher cost incurred on green fodder input, concentrates and human labour. The net returns from a cross-bred cow, buffalo and local cow were about INR 696, INR 425 and minus INR 451 respectively based on revenue from milk production only. This again indicated that the cross-bred cow was more profitable than the buffalo on small farms as well. The break-even analysis of buffalo keeping showed that milk production of 1307 l/cow/yr covered only gross cost of production (Singh, 1988) due to low milk price received by the farmers. The local cow could not generate sufficient gross income to cover the gross cost of production. Further, family labour income generated by a cross-bred cow was about 3.7 times higher than that of a local cow on small farms. However, there was a big gap between the dairy income obtained on Dairy Demonstration Units and small farms. This gap can be due to various reasons which need to be identified.

Table 2 Cost and income breakdown for milch animals on small farms in ORP

Items	Cross-bred cow		Buffalo		Local cow	
	INR/animal/yr	% of total	INR/animal/yr	% of total	INR/animal/yr	% of total
VARIABLE COST						
Green fodder input	673	13	620	13	478	14
Dry fodder	679	13	836	17	635	19
Concentrates	617	12	526	11	175	5
Veterinary and Misc.	135	3	117	3	44	1
Human labour	1278	25	1024	21	984	30
Total variable costs	3382	66	3123	65	2316	69
FIXED COST						
Land rent	380	7	350	7	270	8
Depreciation and interest on fixed capital	1420	27	1365	28	761	23
Total fixed cost	1800	34	1715	35	1031	31
Gross cost	5182	100	4838	100	3347	100
RETURNS						
Milk production (l)	1837		1253		905	
Gross return from dairying	5878[1]		5263[2]		2896[1]	
Gross margin	2496		2140		580	
Net return	696		425		(-) 451	
Family labour income	1974		1449		533	

[1] 3.2 INR per liter; [2] 4.2 INR per liter

It has been reported that inclusion of dairy enterprise in crop farm plans increased farm income and employment on small farms as reported by Devadoss *et al.* (1985) and Sirohi *et al.* (1980). This may be true for many of the mixed farming systems in India, though dairy farming may not be profitable in the situations where favourable price ratios of milk and feed do not exist. Further rationalization of the use of resources in crop, dairy and poultry farming may lead to increased labour absorption in

mixed farming systems on small farms where disguised unemployment exists. Thus, introduction of dairy enterprise with cross-bred cows in mixed farming systems could increase income and employment potential on small farms (Singh *et al.*, 1981).

Economics of Crop Farming System

Based on the random sample of 40 farms in the ORP area, nearly 67% of the total cropped area during the year was occupied by paddy and wheat crops. About 20% of the cropped area was allocated to fodder production in the ORP area as against only about 4% in the country as a whole. This higher area under fodder crops is due to good irrigation facility and concerted efforts made for the development of fodder resources in the cattle development program of the project, particularly the introduction of cross-bred cows.

Table 3 Economics of paddy and wheat production in on-farm research trials and small farms (INR per hectare).

Items	On-farm research in ORP areas				Small farms in ORP areas			
	Paddy		Wheat		Paddy		Wheat	
	INR/ha	% of total	INR/ha	% of total	INR/ha	% of total	INR/ha	% of total
VARIABLE COST								
Seed	79	1	375	5	73	1	299	4
Fertilizers	1223	14	1086	14	1082	13	984	13
Manure	-	-	-	-	39	0	-	-
Human labour	1911	22	980	12	2126	24	995	13
Bullock labour	165	2	182	2	301	3	261	3
Tractor charges	900	10	888	11	658	8	878	12
Tubewell charges	414	5	164	2	453	5	137	2
Other cash expenses	177	2	405	5	126	1	100	1
Interest on cash expenses	87	1	90	1	50	1	65	1
Total variable cost	4956	56	4170	52	4908	56	3719	49
TOTAL FIXED COST*	3876	44	3876	48	3876	44	3876	51
Gross cost	8832	100	8046	100	8784	100	7595	100
Yield (kg/ha)	5900		4500		5000		3200	
Gross income**	13532		11587		12705		8519	
Net income	4700		3541		3921		924	

* This includes depreciation and interest on the value of fixed assets, such as farm shed, machinery, equipments etc. ** includes income from straws as per opportunity cost.

To fill the existing yield gap in crop productivity, on-farm crop research trials of various cereal, fodder, pulses and cash crops are conducted on farms in the ORP villages. To examine the profitability, the cost/revenue breakdown of most important cereal crops, viz., paddy and wheat production on small farms in the ORP area are compared to the on-farm research trials conducted in ORP. Table 3 shows that the total variable cost in on-farm research trials was higher than that of sampled small farms mainly due to higher fertilizer and tractor use which has

led to higher grain yield and higher income. The average yield in on-farm research trials (OFR) was about 5900 kg/ha as against 5000 kg/ha on small farms. The net income obtained from paddy in OFR trials was approx INR 4700/ha as compared to INR 3921/ha on small farms. Similarly, in case of wheat, better quality seed and higher fertilizer dose gave higher yield and net income in on-farm research trials than on small farms. It may be concluded that productivity and net income of crops in crop farming sub-system on small farms can be increased through the rational use of improved inputs which can be demonstrated by conducting on-farm as opposed to pilot units crop research trials.

Economics of Mixed Farming Systems

Dairy farming in the Indian context is mostly an integral part of mixed farming, with a wide variety of crop and animal interactions. To synthesize data on 'improved practices' into a synthetic farm model, we created the "On-farm Mixed Farming System Model". Table 4 summarizes costs and returns for 3 separate farm activities, each of one acre : the cross-bred cow and buffalo units from the Dairy Demonstration Units and the crop costs and returns from the on-farm crop trials conducted with farmers in the ORP villages. The summary represents the potential of a mixed farming system on 3 acres but simplifies for crop inputs (straw, stover, bran, etc.) into the livestock system or vice-versa by calculating their opportunity costs.

This mixed farming system is then compared to two groups of farms identified in the random survey of 40 farms carried out in ORP villages. These sample farms average 3 acres each and are thus comparable in size to the model mixed farming system. The difference between small farm system I and II represents the fact that two different combinations of dairy animals were kept on 0.5 acre devoted to fodder crops and the remaining 2.5 acres have been allocated to paddy-wheat rotation. In case of dairy system I, one buffalo and one local cow along with one buffalo heifer and two young stock were maintained while in the case of dairy sub-system II, one buffalo and one cross-bred cow alongwith one cross-bred heifer and two young stock were raised.

Net returns from the mixed farming system in the demonstration unit was INR 10866 as compared to INR 4124 and INR 5352 from mixed farming system on small farm in situations I and II, respectively (see Table 4). Similarly, human labour absorption and family labour income in the mixed farming system was considerably higher than that of mixed farming systems I and II on the survey farms. Integration of three farming sub-systems on the demonstration farm can further increase the income through rational use of resources and interrelations between the sub-systems. Introduction of cross-bred cows along with improved package of practices in dairy and crop farming systems can substantially increase income and employment on small holdings as the existing farming systems are relatively less efficient.

Net income from dairy farming sub-system with one buffalo and one local cow was negative due to low productivity of the animals, i.e. incomes and human labour absorption in the existing mixed farming systems on small farms is low due to low animal and crop productivity. This needs to be improved through introduction of new technologies in dairy and crop farming sub-systems.

Table 4 Economics of Dairy, Crop and Mixed Farming Systems on Demonstrations/On-farm Research Trials and Small Farms.

Items	Demonstration farm results				ORP survey					
					Small Farms - I			Small Farms -II		
	3 cross-bred cows on one acre	3 buffaloes on one acre	Crop farming on one acre	Mixed farming on three acres	Dairying (buff + local cow on 0.5 acre	Crop farming on 2.5 acres	Total of dairy + crop	Dairying (buff.+ crossbr cow on 0.5 acre	Crop farming on 2.5 acres	Total of dairy + crop
Variable cost	19313	17434	3651	40398	8153	8626	16780	9250	8626	17876
Fixed cost	9675	11040	3101	23816	3126	7752	10878	3785	7752	11537
Gross cost	28988	28474	6752	64214	11279	16378	27658	13035	16378	29413
Gross return	33259	31773	10048	75080	10558	21224	31782	13541	21224	34765
Gross margin	13946	14339	6397	34682	2405	12598	15002	4291	12598	16889
Net return	4272[2]	3299	3296	10866	-721[2]	4846	4124	506[2]	4846	5352
Family labour income	9271	8299	4453	22023	1937	6291	8229	3523	6291	9814
Human labour employment (days)	365	365	84	814	194	146	340	220	146	366

[1] total from cross-bred cattle and buffaloes and crops;
[2] too high because young stock is not included

CONCLUSIONS

Based on the above results, it may be concluded that for the area under study, mixed farming with cross-bred cow in the dairy component generates higher income and employment than the local cows on small farms. Further, introduction of specialised dairy units of cross-bred cows/buffaloes along with high yielding varieties of crops and new technlogy of crop production on small farms has potential for higher income and employment. Therefore, there is a need to develop and introduce improved farming systems to increase income and employment of the small holders through the adoption of Farming Systems Research approach.

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