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Interdependence of the various components of different farming systems of different climatic zones of Jammu regions

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Abstract
The present investigation was conducted in three agro-climatic zones namely temperate, intermediate and sub-tropical zones of Jammu region. Four blocks from each agro-climatic zone and two villages from each block were selected randomly for the present study. From each village, respondents were selected randomly using proportional allocation method, so as to constitute a total sample size of 80 in each climatic zone and overall total sample of 240. The input-output model was used to examine the inter-linkages between the various enterprises of the farming system. The transaction matrix results indicated that the family labour had the highest input-output coefficient for all the consuming sectors for all the farming systems in all the zones. However, weak inter-linkages were observed between various enterprises.

Keywords: Farming system, inter link ages, input-output model

Introduction
India, one of the largest emerging economies of the world accounts for some 2.4 percent of the world's landmass but is home to about 17.52 percent of the global population (Anonymous, 2011a) [2]. The Indian economy is predominantly agrarian and agriculture is a primary source of livelihood providing employment directly or indirectly to 58 percent of its population (Anonymous, 2012) [1]. According to the recent census of India 2011, the population of the country has increased by more than 181 million during the first decade of the 21st century. Simultaneously the agricultural land is decreasing day by day due to the diversion of the agricultural land towards other sectors particularly the industry leading to the decline in per capita availability of land from 0.5 ha in 1950-51 to 0.15 ha by the turn of the century and a projected further decline to less than 0.1 ha by 2020. In the state of Jammu and Kashmir as well the agriculture occupies an important place in the economy. The share of agriculture and allied sectors in the Gross State Domestic Product stands at 28.61 percent. On the other hand nearly 70 percent of the population in the state derives its livelihood directly or indirectly from the agriculture sector (Anonymous, 2011b) [3]. Due to the rapid increase in the population and the decrease of agricultural land, no single farm enterprise is likely to be able to sustain the small and marginal farmers without resorting to integrated farming systems for the generation of adequate income and gainful employment year round (Mahapatra, 1994) [5]. Further, the resources should be optimally utilised so as to increase the productivity of the land which will result in the increase in the income of the farmers and increase their bargaining power. The agriculture in the state is mainly for the subsistence purposes which have resulted in the low productivity of the major crops of the state. The climate of the state is varied particularly Jammu region and this region falls under three agro-climatic zones as classified by NARP. Also this remains the major reason for the sub-optimal utilization of the land and other resources. Keeping in view the above facts, this study was taken so as to propose the optimum model for each agro-climatic zone of the region.

Materials and Methods
The present study was conducted in all the three agro-climatic zones of Jammu region of the state of Jammu and Kashmir (India) as per the NARP classification. Jammu division of the state as per NARP classification is divided into three agro-climatic zones namely subtropical zone, intermediate zone and temperate zone. A three stage random sampling was adopted for the selection of samples, with blocks as the first stage sampling unit, villages as the second stage sampling units and respondents as third stage sampling in all the three zones. Four blocks from each zone were selected for the present study.

Two villages from each block were selected randomly for the study. Then for each selected village, a list of farmers were prepared and farmers from each village were selected for the sample survey on the basis of proportional allocation so as to make the total sample size of 80 in each zone and overall total sample of 240 farmers. To quantify interdependence among the various components of farming systems, the static input-output model was used. The input-output may be described by the following equation

$S_i = \sum S_{ij} + H_i$ (i=1, 2, 3… m; j = 1, 2, 3… n)

Where S_i is the output of any intermediate sector and S_{ij} represents component flows from i^{th} sector to the j^{th} sector and H_i is the final output for household consumption and market.
The above equation can also be written as

$S_i - \sum S_{ij} = H_i$ (i=1, 2, 3… m; j = 1, 2, 3… n)

The relationship thus obtained can be expressed in terms of production coefficients (a_{ij}) and may be described as follows:

$$a_{ij} = \frac{S_{ij}}{S_j} \quad (i=1, 2, 3\ldots m; j = 1, 2, 3\ldots n)$$

This may also be expressed as
$S_{ij} = a_{ij} S_j$
Where S_j = Total output of sector 'j' In the above equation, 'a_{ij}' gives the value of produce of i^{th} sector required by sector 'j' per unit value of output of sector 'j' Thus the model can be also be written as

$S_i - \sum a_{ij} S_j = Hi$ (i=1, 2, 3… m; j = 1, 2, 3… n)

Results and Discussion

The comparison of linkages across the various enterprises as presented in Table 1 indicated that input output coefficients of different enterprises were highest in case of labour for livestock based farming systems in temperate zone of Jammu region, however the forward linkages (crop to livestock as well as crop to poultry) were stronger as compared to backward linkages (livestock to crop and poultry to crops). The weak backward linkages suggested that there is a need to strengthen backward linkages of crops with livestock as well as poultry. The weak linkages could be attributed to the low use of FYM, substitution of FYM by the chemical fertilizers and the use of tractors instead of bullocks. Arya and Kalla (1992) [6] also had similar findings in a study in Haryana. Kumar and Jain (2002) [4] also observed stronger forward linkages as compared to the back linkages in semi-arid parts of India. The share of market inputs was low for the production of various enterprises, hence showing a high interdependency among the various enterprises of the farming systems.

The data presented in Table 2 revealed that the crops consumed inputs from all the enterprises of the farming system in cereal based farming systems of temperate zone, while as livestock and poultry consumed inputs from crops only. The input output coefficients of different enterprises were highest with family labour indicating the high dependence of raising different enterprises on the family labour. The share of market inputs was low for the production of various enterprises, hence showing a high interdependency among the various enterprises of the farming systems. However in case of crops, the market share of inputs was more mainly because of the fact that the fertilizers were one of the important components of production and the farmers have to purchase them from the market. The high input output coefficients of different enterprises were also observed by Kumar and Jain. In cereal based cropping system also, the forward linkages (crop to livestock as well as crop to poultry) were stronger as compared to backward linkages (livestock to crop and poultry to crops suggesting a need to strengthen backward linkages of crops with livestock as well as poultry, which were in close conformity to the findings of Arya and Kalla (1992) [6]. Kumar and Jain (2002) [4] also observed stronger forward linkages as compared to the back linkages in semi-arid parts of India, hence confirming our results.

The comparison of linkages across the various enterprises as presented in Table 3 indicated that input output coefficients of different enterprises were highest in case of labour for fruit based farming systems in intermediate zone of Jammu region, however the forward linkages (crop to livestock) were stronger as compared to backward linkages (livestock to crop), thus indicated a need to strengthen backward linkages of crops with livestock. The share of market inputs was low for the livestock, hence showing a high dependency of livestock on crops. The share of market inputs in case of crops was high mainly because farmers applied large quantities of chemical fertilizers and pesticides on fruits which cannot be produced on the farm, thus the farmers have to purchase them from the market. Kumar and Jain (2002) [4] also observed stronger forward linkages as compared to the back linkages in semi-arid parts of India, hence confirming our results.

The data presented in Table 4 revealed that the crops consumed inputs from all the enterprises of the farming system in cereal based farming systems of intermediate zone, while as livestock and poultry consumed inputs from crops only. The input output coefficients of different enterprises were highest with family labour indicating the high dependence of raising different enterprises on the family labour. The share of market inputs was low for the production of various enterprises, hence showing a high interdependency among the various enterprises of the farming systems. However in case of crops, the market share of inputs was more mainly because of the fact that the fertilizers were one of the important components of production and the farmers have to purchase them from the market. The high input output coefficients of different enterprises were also observed by Kumar and Jain. In cereal based cropping system also, the forward linkages (crop to livestock as well as crop to poultry) were stronger as compared to backward linkages (livestock to crop and poultry to crops suggesting a need to strengthen backward linkages of crops with livestock as well as poultry, which were in close conformity to the findings of Arya and Kalla (1992) [6]. Kumar and Jain (2002) [4] also observed stronger forward linkages as compared to the back linkages in semi-arid parts of India, hence confirming our results.

The comparison of linkages across the various enterprises as presented in Table 5 indicated that input output coefficients of different enterprises were highest in case of labour for livestock based farming systems in intermediate zone of Jammu region, however the forward linkages (crop to livestock as well as crop to poultry) were stronger as compared to backward linkages (livestock to crop and poultry to crops). The weak backward linkages suggested that there is a need to strengthen backward linkages of crops with livestock as well as poultry. The weak linkages could be attributed to the low use of FYM, substitution of FYM by the

chemical fertilizers and the use of tractors instead of bullocks. Arya and Kalla (1992) [6] also had similar findings in a study in Haryana. Kumar and Jain (2002) [4] also observed stronger forward linkages as compared to the back linkages in semi-arid parts of India. The share of market inputs was low for the production of various enterprises, hence showing a high interdependency among the various enterprises of the farming systems.

The comparison of linkages across the various enterprises as presented in Table 6 indicated that input output coefficients of different enterprises were highest in case of labour for livestock based farming systems in subtropical zone of Jammu region, however the forward linkages (crop to livestock as well as crop to poultry) were stronger as compared to backward linkages (livestock to crop and poultry to crops). The weak backward linkages suggested that there is a need to strengthen backward linkages of crops with livestock as well as poultry. The weak linkages could be attributed to the low use of FYM, substitution of FYM by the chemical fertilizers and the use of tractors instead of bullocks. Arya and Kalla (1992) [6] also had similar findings in a study in Haryana. Kumar and Jain (2002) [4] also observed stronger forward linkages as compared to the back linkages in semi-arid parts of India. The share of market inputs was low for the production of various enterprises, hence showing a high interdependency among the various enterprises of the farming systems.

The data presented in Table 7 revealed that the crops consumed inputs from all the enterprises of the farming system in cereal based farming systems of subtropical zone, while as livestock and poultry consumed inputs from crops only. The input output coefficients of different enterprises were highest with family labour indicating the high dependence of raising different enterprises on the family labour. The share of market inputs was low for the production of various enterprises, hence showing a high interdependency among the various enterprises of the farming systems. However in case of crops, the market share of inputs was more mainly because of the fact that the fertilizers were one of the important components of production and the farmers have to purchase them from the market. The high input output coefficients of different enterprises were also observed by Kumar and Jain. In cereal based cropping system also, the forward linkages (crop to livestock as well as crop to poultry) were stronger as compared to backward linkages (livestock to crop and poultry to crops suggesting a need to strengthen backward linkages of crops with livestock as well as poultry, which were in close conformity to the findings of Arya and Kalla (1992) [6]. Kumar and Jain (2002) [4] also observed stronger forward linkages as compared to the back linkages in semi-arid parts of India, hence confirming our results.

Table 1: Transaction matrix for livestock based farming systems in temperate zone of Jammu region (`/household)

Producing Sectors	Consuming Sectors			Gross Returns
	Crop	Livestock	Poultry	
Crop	119.46 (0.007)	8543.49 (0.186)	258.58 (0.091)	17949.96
Livestock	159.29 (0.009)	0.00 (0.000)	0.00 (0.000)	45881.89
Poultry	39.00 (0.002)	0.00 (0.000)	0.00 (0.000)	2835.43
Labour	4265.37 (0.238)	31516.66 (0.687)	987.43 (0.348)	
Market	1673.33	814.29	0.00	

Figures in parenthesis are input-output coefficients

Table 2: Transaction matrix for cereal based farming systems in temperate zone of Jammu region (`/household)

Producing Sectors	Consuming Sectors			Gross Returns
	Crop	Livestock	Poultry	
Crop	165.10 (0.004)	863.55 (0.052)	161.26 (0.093)	40687.40
Livestock	280.67 (0.007)	0.00 (0.000)	0.00 (0.000)	16536.63
Poultry	26.00 (0.001)	0.00 (0.000)	0.00 (0.000)	1742.06
Labour	8592.82 (0.211)	4081.49 (0.247)	516.53 (0.297)	
Market	2830.18	163.46	0.00	

Figures in parenthesis are input-output coefficients

Table 3: Transaction matrix for fruit based farming systems in intermediate zone of Jammu region (`/household)

Producing Sectors	Consuming Sectors			Gross Returns
	Crop	Livestock	Poultry	
Crop	5118.57 (0.006)	4279.27 (0.059)	0.00 (0.000)	834840.00
Livestock	6851.02 (0.008)	0.00 (0.000)	0.00 (0.000)	72000.00
Poultry	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	-
Labour	265898.70 (0.319)	28486.77 (0.396)	0.00 (0.000)	
Market	66777.71	790.00	0.00	

Figures in parenthesis are input-output coefficients

Table 4: Transaction matrix for livestock based farming systems in intermediate zone of Jammu region (`/household)

Producing Sectors	Consuming Sectors			Gross Returns
	Crop	Livestock	Poultry	
Crop	547.70 (0.010)	1815.79 (0.034)	315.69 (0.110)	55949.84
Livestock	946.02 0.017)	0.00 (0.000)	0.00 (0.000)	53974.77
Poultry	38.00 (0.001)	0.00 (0.000)	0.00 (0.000)	2877.22
Labour	21756.50 (0.389)	10959.60 (0.203)	839.22 (0.292)	
Market	8426.41	216.67	0.00	

Figures in parenthesis are input-output coefficients

Table 5: Transaction matrix for cereal based farming systems in intermediate zone of Jammu region (`/household)

Producing Sectors	Consuming Sectors			Gross Returns
	Crop	Livestock	Poultry	
Crop	723.81 (0.017)	5191.41 (0.108)	235.81 (0.104)	42827.54
Livestock	1046.74 (0.024)	0.00 (0.000)	0.00 (0.000)	48066.67
Poultry	50.00 (0.001)	0.00 (0.000)	0.00 (0.000)	2272.42
Labour	22347.26 (0.522)	35044.59 (0.729)	607.27 (0.267)	
Market	9314.94	400.00	0.00	

Figures in parenthesis are input-output coefficients

Table 6: Transaction matrix for livestock based farming systems in subtropical zone of Jammu region (`/household)

Producing Sectors	Consuming Sectors			Gross Returns
	Crop	Livestock	Poultry	
Crop	549.96 (0.020)	16272.63 (0.359)	413.68 (0.182)	26921.59
Livestock	754.24 (0.028)	0.00 (0.000)	0.00 (0.000)	45296.17
Poultry	30.00 (0.001)	0.00 (0.000)	0.00 (0.000)	2274.74
Labour	8615.22 (0.320)	12206.83 (0.269)	1050.25 (0.462)	
Market	6522.42	780.49	0.00	

Figures in parenthesis are input-output coefficients

Table 7: Transaction matrix for cereal based farming systems in subtropical zone of Jammu region (`/household)

Producing Sectors	Consuming Sectors			Gross Returns
	Crop	Livestock	Poultry	
Crop	553.74 (0.018)	964.32 (0.022)	361.81 (0.175)	31616.32
Livestock	732.64 (0.023)	0.00 (0.000)	0.00 (0.000)	44560.00
Poultry	45.00 (0.001)	0.00 (0.000)	0.00 (0.000)	2064.27
Labour	11425.92 (0.361)	3561.07 (0.080)	909.85 (0.441)	
Market	7187.66	38.46	0.00	

Figures in parenthesis are input-output coefficients

Conclusion

From the present study it was thus concluded that cereal based farming systems were predominant in the temperate zone of Jammu region with maize as the predominant crop. The forward linkages were stronger as compared to backward linkages in both livestock and cereal based farming systems.

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