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Growth and Regional Variation of Major Crops in Nepal

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Abstract

This paper attempts to examine the growth performance and its regional variation of the major crops of Nepal on the basis of the time series data from 1974 to 1999 years. The growth preferences have been analyzed taking the area under crops, production and the yields of major crops including cereal and cash crops. Compound annual growth rates and the trends of growth of these variables has been computed for three different periods from 1974 to 1999 and compared across the crops and development regions of Nepal. Similarly, multiple regression has been run to look upon the determinants of yields of the major crops.

Growth performance of crop sector in Nepalese agriculture was not so encouraging as compared to neighboring countries since Nepal has not yet experienced any technological shift like the Green Revolution. Although the overall growth found to be positive its pace seems quite slow. Area extension and crop shifting found to be more contributing rather than productivity improvement, reflecting the predominance of traditional mode of farming. There was significant variation of growth in area, production and yields of crops across region and the periods. The decade of the 80s witnessed relatively better than the 70s and the 90s in terms of growth reflecting the policy shift across these periods. The determinants of growth were found to be rather unexpected since the coefficients of the variables like area under irrigation, improved seeds, and the fertilizer appeared to be negative. On the other hand, the credit and government investment in agriculture was found to be significantly positive showing no considerable influence on growth of yields of major crops.

Introduction

Nepal is one of the poorest countries in the world with a very backward but dominant agricultural economy. It is evident from the fact that agricultural sector alone contributes

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more than 40 percent to the gross domestic product of the country and provides employment to 81.1 percent of its working population. Similarly it has significant role to supply raw materials for industries and to international trade as well. But the sector is itself is in traditional mode in terms of technological adaptation and the commercialization. The aim to modernization and commercialization of the agricultural sector seems to be in vain in spite of the various efforts made by the government in its successive nine development plans. Almost all of the agricultural land in Nepal is under private ownership. So one cannot expects much from the government since its role in this sector could be supportive rather than direct. Thus the private sector should be proactive for agricultural growth as the theory suggests. However, the private sector seems not to be keen to have been active for higher growth by adopting modern technology. It may be due to the lack of inducement of high payoff owing to the lack of proper inducement from government and lack of market and infrastructure facilities. Whatever progress is seen in agriculture is more or less directly related to the public sector initiatives and foreign assistance in research, training and extension programmes across various sub-sectors of agriculture. Though the process of diversification and commercialization is seen to be initiated in some pockets areas located in the vicinity of the urban centers and along the highways, the extent and pace of change is too slow. Similarly, the farmers of Terai and valleys are found to be encouraged to use the modern inputs in their own ways not in efficient ways that ought to be.

Still crop farming is a dominant sub sector in Nepalese agriculture. It is highly staple based. It is evident from the facts that in total cropped area, more than two-third is devoted to cereal crops and pulses as compared to nearly 10 percent in cash crops. Farming still highly depends on monsoon since only 21 percent of the cultivated area receives year round irrigation. Similarly farmers have very low access to institutional agricultural credit, marketing and storage facilities. In this context, this paper intends to examine the various facets of growth performance of Nepalese agriculture. The major focus, however is to look upon the following issues:

- State of growth in area under cultivation, Production and yields of major crops.
- Relative strength of area and productivity factor in growth of the crops.
- Growth trends of area, production and yields of the crops.
- Regional variation in growth of the crops.
- State of influence of the modern inputs on yields of major cereal crops.

This paper is organized in four parts. This current section gives a brief background and the issues of Nepalese agriculture. The second section deals with the data and methodology while the third section is a main body of the paper in which the presentation and discussion of the results have been given. The last section covers the conclusions.

Data Base and Methodology

The following sources of data have been used in this study:

i. Economic survey 1999-2000, Ministry of Finance, His Majesty's Government of Nepal.
ii. Statistical Yearbook 1998, Central Bureau of Statistics (CBS), HMG/N.
iii. Statistical Pocket Book, CBS.

iv. Statistical Information on Nepalese Agriculture 1998/99, Ministry of Agriculture, HMG/N.

For national level analysis, the time series of the period 1974-75 to 1999 –2000 has been used. The regional level analysis, however, has to be restricted to the period 1986-87 to 1998-99 since the required data could not be found for the whole reference period. The analysis has been done using the following tools and methods:

• Compound Annual Growth Rate (CAGR):

The CAGR of area, production and yields of major cereal and cash crops were estimated using the following formula:

$$CAGR=((P_1/P_o)^{1/N}-1)*100$$

Where, P1 and Po are the current and base year figures of area, production and yields of crops under consideration for different years respectively and N is the number of years for the reference periods. The whole reference period was divided into three sub periods, namely 1974-76 to 1980-82 as first period; 1980-82 to 1990-92 as second period and 1990-1997-1999 as third period to facilitate the comparison of the growth across periods. The rates have been computed taking terminal averages for all crops to minimize the possible monsoon effect on the growth rates.

• Linear Regression Models:

To identify the growth trends of are under major crops, and that of production and yields the semi-log linear regression of the following quadratic forms (taking time as independent variable) has been run:

$$\text{Log } Y_i = a + bT + cT^2$$

Where, Y represent the area under, production and yields of particular crops under consideration; T indicates the time variables and a, b, and c are the regression coefficients in which c gives the value of trend growth rates for respective dependent variables.

To examine the impact of modern inputs on yields, the linear regression of the following form has been run:

$$Y_i = a + b_1 X_{1i} + b_2 X_{2i} + b_3 X_{3i} + b_4 X_{4i} + b_5 X_{5i} + m_i$$

Where,

Y_i = Yields of cereal crops (Kg/ Hector)

X_{1i} = Quantity of Chemical fertilizer used (in MT);

X_{2i} = Quantity of improved seeds applied (in MT);

X_{3i} = Cumulative irrigated area (in hectors);

X_{4i} =Amounts of Agricultural credit disbursement made by Agricultural Development Bank in Million Rupees;

X_{5i} = Amounts of Government's development expenditure made in agricultural sector; a and b_i are parameters and the m_i the error term.

Results and Discussions

This section has four sub-sections. First we discuss the growth performance of the major crops at national level. It is followed by the growth trends analysis of the area, production and

yields of the same. In the third section, the regional variation of the growth crops' area, production and yields is discussed. Last section covers the analysis of the regression results regarding the determinants of yields for cereal crop.

Crop wise Growth Performance at National Level

Cereal Crops

As we have indicated above, the agricultural growth in Nepal depends heavily on the performance of the crop sector in general and the cereal crops in particular since other sectors and crops still remain in nascent stage. It is evident from the fact that cereal crops occupy about 80 percent cropped area and share about 75 of the crop production. Despite having appropriate landscape and climate for horticultural production, people are not keen to shift their traditional farming practices and cropping pattern substantially. It may partly due to the belief among most of the farmers that only cereal crops can support their livelihood and partly due to the unavailability of irrigation facility, access to modern inputs and markets and also the lack of technical support and extension services. Following section deals with the growth pattern of major cereal crops, namely paddy, wheat, maize, millet and barley in terms of area, production and yields.

Table 1: CAGR of area, production and yields of major cereal crops
(Fiscal year 1973/74 - 1998/99)

Cereal Crops		Per cent CAGR			
		I	II	III	Whole period
Paddy	A	0.34	0.88	1.25	0.85
	P	-1.36	3.25	2.72	1.86
	Y	-1.69	2.34	1.45	1.00
Maize	A	1.04	4.71	0.82	2.55
	P	-1.15	5.33	1.57	2.47
	Y	-2.17	0.60	0.75	-0.08
Wheat	A	4.05	3.39	1.30	2.92
	P	7.42	3.67	4.65	4.93
	Y	3.23	.27	3.32	1.96
Millet	A	0.00	4.84	4.06	3.32
	P	-2.38	6.64	3.24	3.18
	Y	-2.38	1.71	-0.79	-0.13
Barley	A	0.00	1.44	0.93	0.91
	P	-1.44	2.44	2.37	1.39
	Y	-1.44	0.98	1.44	0.48
Total Cereal	A	1.17	2.46	1.36	1.79
	P	-0.33	3.87	2.79	2.43
	Y	-1.49	1.37	1.41	0.63

Notes: 1. A= Area under crop, P = Production and Y = Yields
2. Period I = 1974/76 to 1980/82, II = 1980/82 –1990/92
III = 1990/92 – 1997/1999 and IV = 1974/76 – 1997/99
Source: Economic Survey 1999/2000. Ministry of Finance, HMGN.

Table 1 presents the compound annual growth rates (CAGRs) of the area, production and yields of the major cereals crops for three different periods and the whole reference period as well. Table reveals considerable variance in growth rates among crops and across periods. For the country as a whole, the resulting growth rates of production of cereal crops were -0.33, 3.87 and 3.87 percent per annum in 1970s, 1980s and 1990s respectively. As compared to 70s and 90s the growth was relatively impressive in 80s. It is evident from Table1 that slightly higher rates in area were observed in 70s and 80s as compared to that of yields. The decade 90s recorded almost the same growth rates for both area under crops and yields for all the cereal crops contributing 2.79 percent growth in production of cereals as a whole. However, it was slightly higher than that of 80s. If we look at the whole reference period moderate rates of growth in production emerged irrespective of the crops in which area extension was more pronounce than the yields as a contributing factor for growth of production.

Let us see on the crop wise growth pattern. CAGRs in late 70s were almost negative for paddy, barley and millet but positive and impressive for wheat, the newly adopted crop. For all crops, 1980s marked considerably higher growth performance than seventies. Except paddy, the higher growth of production was mainly associated to the extension of area rather than yield since the growth rates of area was positive for all cereals except paddy. It may due to the fact that in this period wheat was massively introduced irrespective of ecological belt and maize, which was mainly a hilly crop before also started cropping in Terai plain and valley, whereas paddy has been remained stagnate since it was being a traditional crop. Due to the limitation of suitable land for paddy in Nepal, one can not expects considerable expansion. The growth rate of production in 1990s, however, slowed down for all cereal crops except wheat. But the CAGRs in terms of yield were not uniform in the 90s.The growth rate of area under paddy exceeded the previous period whereas opposite observed that of the other crops. The CAGRs of yields of paddy and millet declined sharply but in case of wheat, maize and barley it inclined markedly.

Though it is difficult to establish firmly whether yields or area extension mattered for the growth of production of all cereals, it is evident from the analysis that for paddy, growth of yields was found stronger than area while for other crops, area factor was more impressive. However, over successive periods, the relative CAGRs marked highly fluctuating pattern.

Cash crops

The diversification of the cropping pattern in favor of cash crops is widely suggested strategy for modernization and commercialization of the crop sector and much talked policy matter of agricultural development for any country. Nepal could not be an exception in this regard. Although Nepal's cropping pattern is highly dominated by cereal crops some degree

of diversification has been taking place through the successive periods. A wide range of cash crops such as sugarcane, potato, oilseeds, tobacco jute, tee, coffee, ginger, cardamom and cotton are grown in Nepal. Among them some are traditionally grown and some ware introduced in late 60s. None of the crops seems to be significantly developed yet. In this section we will discuss the growth pattern of the major cash crops in terms of production, area and yields. Due to the lack of time series data for all the cash crops we are bound to restrict the analysis to 5 major crops. The detail of the estimated growth rates of major cash crops has been presented in Table 2.

Table 2 brings out some interesting features of growth pattern in cash crops. The estimates of the CAGRs of different cash crops in terms of area, production and yields for three different periods and for whole reference period are presented in the table. The table reveals almost impressive growth rates in area, production and yields of sugarcane potato and oilseeds in 1970s and 1980s although they slowed down slightly in the 1990s. Whereas tobacco and jute, which were considered to be leading cash crops earlier continuously declined over successive periods. The decrease in growth in tobacco and jute is highly associated with the downfall of the respective industries in the last couple of decades successively. Impressive growth rate of sugarcane may be associated with the establishment of new sugar mills in Terai. The oilseed is a transitional crop and its attractive price may have some bearing on the growth of the crop. As a whole growth in cash crops shows positive development.

Table 2: CAGR of area, production and yields of major cash crops
(Fiscal year 1973/74 to 1999-2000)

Cash Crops		Percent CAGR			
		I	II	III	Whole period
Sugarcane	A	7.51	3.84	5.88	5.41
	P	12.88	8.36	6.36	8.89
	Y	5.00	4.35	0.45	3.33
Oilseeds	A	0.64	3.18	2.41	2.28
	P	2.48	1.41	3.69	2.60
	Y	1.8	-1.24	1.26	0.32
Potato	A	0.22	4.79	4.64	3.53
	P	5.51	8.54	5.46	5.37
	Y	1.29	3.58	0.79	2.12
Tobacco	A	1.60	-0.95	-4.97	-1.54
	P	2.21	1.01	-5.95	-0.87
	Y	0.50	2.09	-1.04	0.69
Jute	A	2.67	-10.61	0.11	-4.07
	P	1.77	-10.79	0.09	-4.38
	Y	-0.90	-0.20	-0.02	-0.32
Total Cash Crop	A	1.46	2.21	3.30	2.34
	P	6.88	7.56	5.87	6.87
	Y	5.37	5.24	2.49	4.42

Source and Notes: Same as Table 1.

If we see the source of growth of output of the crops under consideration area factor seems to be dominating over yield. For instance the growth of area under crops found higher than the rates of growth of yield in case of sugarcane, potato and oilseeds. However over successive periods the growth rates were declining in absolute terms except of potato. The growth rates of yield do not follow the homogeneous pattern. The CAGRs of yields of sugarcane have been declining over time whereas it shows up and down incase of oilseeds. Almost same pattern is followed by potato, tobacco and jute. But the difference is that the growth of yield of jute and tobacco were negative and declining over time. For the cash crops as a whole the growth rates of area followed an increasing pattern whereas the yield growth followed the reverse. The overall growth rate of production of cash crops had recorded an impressive growth in 70s and 80s (6.88 and 7.56 percent respectively) while it slightly decreased in 90s (5.87 percent). In this way, the growth in cash crops experienced a positive and inclining pattern.

Growth Trends of Major Crops

We have discussed above the growth patterns of major crops with the help of estimated CAGRs of the three different periods and the whole reference period. In this section we will look upon the growth trends of the major crops for the whole reference period, that is, for the last three decades. It would be interesting to identify whether the growth trends have been accelerating or decelerating over the periods. For this purpose, trend growth rates of the ten principle crops have been estimated regressing the log values of area under crops, production and the yields of these crops to the time as explanatory variable (i.e, applying the regression model of the form $\text{Log } Y = a + bT + cT^2$). It is widely accepted that the inference about the existence of acceleration or deceleration can be examined on the basis of the sign and the level of significance of the respective coefficient 'c' of the time variable in the quardetic function (Sawat, 1997). The estimated values of coefficients and their test of significance are listed in Tables 3 and 4 for principal cereal and cash crops respectively.

Table 3 reveals contrasting results of the growth trends of cereal crops. For the cereal crops as a whole the coefficients of area and production both appeared as negative but the coefficient of area is significant which clearly shows that there is a decelerating trends of growth of area across the reference period. The production growth trend, however, shows that even if it is decelerating it is not significant. Though the coefficient of yields terns to be positive but it is insignificant even at 10 percent, so we may say there is a very poor accelerating trend in this regard.

Table 3: Estimated results of Quadratic trend function of Cereal crops (Fiscal year 1974-75 to 1998-99)

Crops		Constant	Coefficients		R^2	Trend
			b	c		
Paddy	A	3.090	0.0058	-0.0001**	0.76	Dec
	P	3.360	0.0044	0.0002	0.67	Acc. (NS)
	Y	3.274	-0.0014	0.0003**	0.56	Acc.
Maize	A	2.592	0.0245	-0.0005*	0.85	Dec
	P	2.836	0.0113	0.0001	0.81	Acc
	Y	3.245	-0.0132	0.0006*	0.52	Acc
Wheat	A	2.463	0.031	-0.0007*	0.96	Dec
	P	2.516	0.034	-0.0006*	0.96	Dec
	Y	3.053	0.003	0.0008	0.77	Acc
Millet	A	2.048	0.014	0.0001	0.89	Acc (NS)
	P	2.156	-0.005	0.0009*	0.74	Acc
	Y	3.110	-0.019	0.0008*	0.31	Acc
Barley	A	1.416	-0.0004	0.0003*	0.73	Acc
	P	1.375	-0.006	0.0006*	0.81	Acc
	Y	2.960	-0.006	0.0008*	0.72	Acc
Cereal Crop Total	A	3.307	0.025	-0.0002*	0.91	Dec
	P	3.530	0.011	-0.00003	0.77	Dec (NS)
	Y	3.222	-0.013	0.0002	0.33	Acc

Note: * and ** denote significant at 5 and 10 percent level of significance; NS denote non significant, Acc. Accelerating and Dec. decelerating trends.

Source: As Table 1.

If we look at the crop wise trends the table reveals that the coefficients of production and yields of paddy and millet, yields of wheat and maize and the area, production and yields of barley are positive and significant reflecting accelerating trends. The resulting coefficients in case of area under paddy and maize, and area and production of wheat are all negative as well as significant which clearly shows the retardation trends. But remaining variables do not reveal any definite trends.

Table 4 gives the results of trend function for major cash crops. As in cereal crops the trends of growth of cash crops also reveal a mixed pattern. For cash crops as a whole coefficient of area under the crop and production shows accelerating trends over the period but in case of yield there is no definite trends since the coefficient found to be insignificant as if negative. In crop wise results positive and significant coefficients, resulting accelerating trends are found in case of area of sugarcane and oilseeds, yields of tobacco and potato and the production of potato only. In contrast to this decelerating trends appeared in case of production of tobacco and jute, yields of sugarcane and area under tobacco as these have negative and significant coefficients. The remaining variables do not show any definite trends.

Table 4: Estimated results of the quadratic trend function of cash crops (Fiscal year 1974/75 to 1998/99)

Crops		Constant	Coefficients		R^2	Trend
			b	c		
Sugarcane	A	1.233	0.014	0.0003**	0.91	Acc
	P	2.405	0.040	-0.00002	0.95	Dec (NS)
	Y	1.173	0.027	-0.0004*	0.93	Dec
Oilseeds	A	2.051	0.007	0.0001	0.80	Acc (NS)
	P	1.824	0.009	0.00004	0.76	Dec (NS)
	Y	-0.226	0.002	-0.00007	0.03	Dec (NS)
Tobacco	A	0.834	0.017	-0.0009*	0.65	Dec
	P	0.685	0.014	-0.0006*	0.15	Dec
	Y	-0.149	-0.003	0.0003**	0.37	Acc
Potato	A	1.679	0.014	0.0001	0.91	Acc (NS)
	P	2.401	0.020	0.0003	0.94	Acc (NS)
	Y	0.722	0.007	0.0002	0.79	Acc (NS)
Jute	A	1.677	-0.026	-0.0002	0.73	Acc (NS)
	P	1.780	-0.034	0.00007	0.18	Dec (NS)
	Y	0.122	-0.008	-0.0003*	0.84	Acc
Cash Crop Total	A	2.357	0.005	0.0002	0.84	Dec (NS)
	P	2.800	0.026	0.0001	0.98	Dec (NS)
	Y	0.443	0.021	-0.00001	0.91	Acc (NS)

Source and Notes: As in Table 3.

Regional Variation of Growth in Major crops

This section deals with the regional variation of the growth performance of major crops in terms of area under crops, production and yields of the same. Due to the data limitation of the data this analysis is restricted to the duration 1986/87 to 1997/98. There are five development regions officially declared and divided longitudinally from east to west, termed as eastern (EDR), central (CDR), western (WDR), mid western (MWDR) nd far western (FWDR). All the five regions comprise the three ecological belts, Terai, Hills and the Mountains, however not homogeneous in size and land-soil characteristics.

So it would be interesting to look upon regional variation of the growth of crops in terms of area under cultivation, production and yields of major crops, both cereals and cash.

Region wise growth of major cereal crops

Table 5 gives the region wise CAGRs of area, production and yields of major cereal crops for the period of 1986-88 to 1996-98. Table reveals that there is no uniform pattern of

growth of cereal crops across five development regions. In paddy crops all the five regions experienced positive growth in reference period, however exhibits considerable variation across regions. During that period highest growth rates in production was recorded by far-western development region followed by EDR and MWDR respectively. Lowest growth was observed in CDR followed by WDR. These highest growth rates were found associated with higher growth rates of area and yield both but relatively the yield growth rates was found to be contributed more than that or area extensions. It

Table 5: Region wise Growth of cereal crops (FY 1986-88 to 1996-98)

Major Cereal crops		Percent CAGRs				
		EDR	CDR	WDR	MWDR	FWDR
Paddy	A	1.04	0.02	0.69	1.01	1.02
	P	3.71	0.50	2.56	3.35	4.84
	Y	2.65	0.47	1.86	2.32	2.86
Maize	A	2.69	2.21	1.53	0.92	0.82
	P	3.81	3.46	3.37	3.28	4.30
	Y	1.09	1.24	1.81	2.34	3.45
Wheat	A	2.86	1.11	0.28	0.54	1.68
	P	4.43	2.38	2.63	3.16	5.47
	Y	1.52	1.25	2.34	2.61	3.73
Millet	A	3.79	9.99	3.45	0.32	-0.15
	P	6.84	11.31	5.15	2.27	1.10
	Y	2.93	1.20	1.64	1.94	1.25
Barley	A	0.55	-1.93	3.95	4.06	-0.64
	P	0.66	-3.10	4.95	5.59	1.35
	Y	0.11	-1.20	1.05	1.46	2.01
All Crops	A	1.80	1.10	1.18	0.92	1.50
	P	3.91	1.64	2.99	3.33	4.75
	Y	2.67	0.53	1.78	2.36	3.20

Note: A is used for area under crop, P for production, and Y for yield of the crop.

Source: *Statistical Year Book 1998 and Statistical Pocket Book 2000,* Central Bureau of Statistics, HMG of Nepal, Kathmandu, Nepal.

Seems to be due to the fact that the during this period the western regions adopted relatively modern techniques and the high yielding varieties of paddy relative to the late eighties as compared to the other regions. If we look at the figures of the maize crops almost same pattern of CAGRs of production have been observed across the regions. But in terms of area higher growth rates were found in EDR followed by CDR and WDR as compared to MWDR and FWDR. However reverse pattern found in growth of yield, i.e. relatively higher rates of growth were recorded in FW and MW development regions than that of rest of the regions. It seems ambiguous to say about this type of irregular pattern.

In case of wheat also growth of production shows a similar pattern as maize. Relatively higher growth was recorded in FWDR in terms of production and yield while lowest growth in area under wheat was observed in WDR followed by MWDR as compared to other regions. Considerable variation was observed in the growth of production of millet and barley. It is evident from the table that highest growth rates of millet in all the aspects were recorded by CDR followed by FDR and WDR respectively. The growth rat e of production of barley was negative in CDR. However the growth rates of these crops in western two regions were extremely lower as compared to the east regions. It may be the indication that western regions have been constantly following the crops diversification with the development of road and other social and economic infrastructure at least in the Terai and the some lower hills regions. Similarly, area factor seems to be dominant in the growth of production of these inferior crops irrespective of the regions. It may be due to the fact that the possibility of having high yielding varieties is very low in the crops and people may be using less modern inputs to increase the yield of these crops.

Region-wise growth of major cash crops

The regional analysis of the growth of cash crops is presented in this section, which may help to understand the relative position of the shift in cropping pattern and variation of the growth across the development regions. Table 6 summaries the growth pattern of major cash crops in terms of area, production and yields for these regions. We have covered only those crops that are grown in all regions to facilitate the comparison. We drop the jute in regional analysis because it is grown only in eastern Nepal.

Table 6 reveals wide variation of the growth rates of crops under consideration in all aspects. High and considerable production growth was recorded in all regions except MWDR for sugarcane. The highest growth was recorded in FWDR in production and area under sugarcane followed by WDR and CDR respectively. However in MWDR the growth of sugarcane production and area extension both recorded quite low. The growth of yield was observed to be followed relatively quite uniform pattern. The impressive growth of the sugarcane is directly linked to the establishment of the sugar industry and expansion of the road access to all the terai region of Nepal in this period.

Potato is another cash crops, which has shown a very impressive growth in all aspects irrespective of the regions. Very low variation was observed in the growth of potato across regions. Area factor is seems to be more contributing to the high growth of production than yield in all regions except FWDR, where the rate or growth in yield exceeds to that of area. Production of the oilseed also recorded positive growth in all regions. Except EDR, which has recorded high growth rates in production, all other regions experience very low growth rates. In EDR also the growth of yield is less than unity that clearly shows that whatever growth is recorded are mainly due to the extension of area under oilseed. In two western regions oilseed yield turn to even negative.

In contrast to above growth pattern of other cash crops, the rate of growth of tobacco was negative in all regions. It is seen in the table that substantial reduction in area under

Table 6: Region wise growth of major cash crops (FY1986-88 to 1996-98)

Major Cash crops		Percent CAGRs				
		EDR	CDR	WDR	MWDR	FWDR
Sugarcane	A	2.25	6.09	5.34	-1.64	14.54
	P	5.36	8.37	8.57	0.32	17.74
	Y	3.04	2.14	3.07	2.04	2.82
Oilseed	A	5.37	1.30	0.88	1.57	0.37
	P	6.13	2.40	1.33	0.41	0.24
	Y	0.72	1.09	0.44	-1.15	-0.13
Potato	A	4.14	2.95	4.34	4.94	1.07
	P	7.11	5.77	5.95	8.61	4.87
	Y	2.85	2.74	1.52	3.49	3.76
Tobacco	A	-4.25	-1.71	-6.16	-2.65	-2.84
	P	-1.20	-0.07	-6.70	0.00	-3.97
	Y	3.19	-1.67	0.57	2.72	1.17

Source: Same as Table 5.

tobacco was responsible to this negative growth in production although growth in yield were also not sufficient enough to offset the negative growth in area where there is positive growth in yield so far. It is evident from the table that the growth in yield in EDR and MWDR was recorded moderate but due to high negative growth of the area under it the growth of production turn to be negative. Highest negative growth rate was recorded by WDR followed by FWDR and EDR respectively. This trend may be due to the fact that the farmer did not see any profit margin in this crops or lack of better technology for this crop.

Determinants of yield growth

To examine the influence of modern inputs on yield of the cereal crops we regress the series of total yield of the cereal crops combined to the five major influencing variables-chemical fertilizer use (X1), use of improved seeds (X2), cumulative area under irrigation (X3), amount of credit disbursed during the period and the government investment on agricultural sector. Different forms of regression models have been worked out to see the impact, i.e. taking absolute physical value of the variables, taking three yearly moving averages, taking log of the amount of all variables series and taking the annual growth rates of variables. But none of the regression models has given expected results. Almost all of the coefficients estimated turned to be insignificant. We are presenting here the regression results of the model based on three yearly moving averages.

The regression results reveal that out of five variables only three emerged to have some influence on the growth of the yield of the cereal crops. The impact of irrigation (X3), credit (X4) and public investment on agriculture show the positive coefficients, however these

coefficients are significant at higher level of significance. These results reflect the fact that these explanatory variables have very weak impact on yields of the cereal crops.

Table 7: Regression results
(Based on three yearly moving averages of the variables)

Variables	Coefficients	SE	t- value
Constant	1764.57	134.82	13.089*
X1	-0.00011	0.0025	-0.044^{NS}
X2	-0.0846	0.0341	-2.4808*
X3	0.2158	0.4922	0.4386^{NS}
X4	0.0436	0.0277	1.5737**
X5	0.0546	0.0688	0.7933^{NS}
$R^2 = 0.82$	Adjusted $R^2 = 0.77$		df = 17

Note: * and ** denote the level of significant at 5 and 10 percent level respectively.

Furthermore, the coefficients of the variables use of chemical fertilizer and use of improved seeds turned out to be negative though the values were very marginal. The coefficient of X2 was significant at 5 percent level while that of X1 was insignificant. It is obviously an odd result for any economists because such results never expected generally. Theoretically, bio-chemical technology is considered to be a high growth source in agriculture., So we can say that in Nepalese agriculture technology found to be ineffective. This kind of results observed due to the deficiency of data. The positive but non significant as well as negative and significant values of regression coefficient my appear due to the highly fluctuating data series on the one hand and may be on account of sub- optimal and insignificant use of inputs. Nevertheless, the result rightly reflects the situation of Nepalese agriculture that is mostly in traditional mode.

Conclusions

The whole discussion over the growth of crop sector of Nepalese agriculture suggests that growth performance of cereal and cash crops was not encouraging if we compared to other underdeveloped countries of Asian continent. The overall performance of cereal crops in terms of compound annual growth rates over the successive periods is found to be positive. But it was too slow. Specifically, paddy, maize, wheat and millet recorded positive growth. Among the cash crops sugarcane and potato showed impressive growth and the oilseed recorded moderate growth while tobacco and jute were appeared to be negative. Across the time periods 80s marked higher growth performance as compared to 70s and 90s. It is an interesting finding that after 1990s afterward the growth followed a declining trend. As regards to the sources of growth area extension and shift of cropping pattern to be found more significant than the yield for most of the crops. It suggests the fact that Nepal is very nascent stage of agricultural transformation.

The analysis of the growth trend reveals that production and yield of crops showed slightly accelerating trend for majority of the crops under consideration while the area followed the declining trend for some traditionally grown crops but inclining trend for modern crops (wheat, sugarcane and potato). Cash crops as a whole found to be slowly accelerating. If we look at the crop wise trend potato showed accelerating trend but jute and tobacco followed retarding trend considerably. Sugarcane and oilseed were found accelerating in area but retarding in production and yield.

In regional analysis, we found that the three western development regions were leading with relatively good growth performance in comparison to central and eastern region. We also can observe similar pattern of growth in terms of area, production and yield. Therefore, we can conclude that there was considerable variation in growth performance of the crops across the development region.

Regarding the determinant of yield of the cereal crop the regression results showed an ambiguous situation. Although expected results did not emerge as per the sign and strength of coefficients, the irrigation, credit and the agricultural investment have shown some impact on the yield of the cereal crop. In case of other inputs like chemical fertilizer and improve seeds there was no definite influence on the yield since the coefficient turn to be negative but insignificant. It is unexpected and odd result. Therefore whole of the results support the obvious fact that Nepalese agriculture particularly the crop sector have been still in traditional mode with very slow pace of transformation. That is why without a comprehensive and deliberate attempt to increase the growth rate of the crops the pace of agricultural transformation cannot be attained. Since there is no high pay-off situation in this sector the role of government should not be reduced at least for some years to come.

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Book Review

Paul R. Krugman and Maurice Obstfeld (2000). ***International Economics: Theory and Policy.*** Addison Welsey Longman (Singapore) Pvt. Ltd. Indian Branch, 482 F.I.E., Patparganj, Delhi 110092, pp. 750. Price: Rs. 450. ISBN 81-7808-079-6.

The study of international trade and money has always been a lively and controversial part of economics. Many key insights of modern economic analysis first emerged due to the debates over international trade and monetary policy during the eighteenth and the nineteenth centuries. The study of international trade is very important today than it was before because the economies of different countries are more closely linked to one another now than ever before. At the same time the world economy is more turbulent than it has been in many decades.

In these circumstances, this book introduces the main concepts and methods of international economics and illustrates them with applications drawn from the real world. It is in large part devoted to the grand tradition of international economics; the nineteenth-century trade theory of David Ricardo and the even earlier international monetary analysis of David Hume remain quite relevant to the modern world. At the same time, this book has made a special effort to bring the analysis up to date. The field of international economics has been in a creative ferment in recent years, with new views emerging on such issues as the political economy of trade policy, strategic trade policy, exchange rate determination, and the international coordination of macroeconomic policies. This book also attempted to convey the key ideas of these new approaches while stressing the continuing usefulness of older ideas.

The book under review covers the most important recent developments in international economics without shortchanging the enduring theoretical and historical insights that have traditionally formed the core of the subject. This comprehensiveness is achieved in this book by stressing on how recent theories have evolved from earlier findings in response to evolving world economy.

This book is divided into four parts. First two parts, from Chapter 2 to 11, deal with the real trade portion and the other two parts, from Chapter 12 to 22, deal with the monetary portion. Both the real trade portion and the monetary portion are divided into a core of chapters focused on theory followed by chapters applying the theory to major policy questions, past and current.

Chapter One describes in some detail how this book addresses the major themes of international economics. The second chapter begins with a general introduction to the concept of comparative advantage, and then proceeds to develop a specific model of how comparative advantage determines the pattern of international trade. Various models of international trade are explained in a clear manner in chapters Three, Four and Five. Chapter Six begins with an overview of the concepts of the economics of scale and the economics of imperfect competition.

Then it turns to two models (monopolistic competition model and the dumping model) of international trade in which economics of scale and imperfect competition play a crucial role. Chapter Seven deals with the various concepts of international factor movements. This chapter's focus remains on the causes and effects of international factor movements, including the implications for income distribution.

Chapter Eight examines the policies that governments adopt towards international trade polices that involve a number of different actions. It provides a framework for understanding the effects of most important instruments of trade policy. In Chapter Nine, the book tries to examine some of the reasons governments either should not or, at any rate, do not base their policies on economists' cost-benefit calculations. The examination of the forces motivating trade policy in practice are made in Chapter Ten and Eleven, which discuss the characteristics trade policy issues facing developing and advanced countries, respectively.

Chapter Twelve deals with the concept of national income and its linkage with international trade. In Chapter Thirteen methods of exchange rate determination and its role in international trade are discussed. The next three chapters examine these topics by building an economic model that links exchange rates, interest rates, and other important macroeconomic variables such as inflation rate and output. However, Chapter Seventeen discusses how central banks intervene in the foreign exchange rates and how macroeconomic policies work when exchange rates fixed.

Chapter Eighteen examines how the international monetary system influenced macroeconomics policy-making and performance during three periods: the gold standard era, the inter-war period, and the post-World War II years during which exchange rates were fixed under the Bretton Woods agreement. In Chapter Nineteen, fixed and floating exchange rates are applied to examine the recent performance of floating rates and to compare the macroeconomics policy problems of different exchange rate regimes. Chapter Twenty focuses on European's experience of monetary unification to illustrate the economic benefits and costs of fixed exchange rate agreements and move comprehensive currency unification schemes. Chapter Twenty-one discusses about the questions associated with international capital market. Finally, Chapter Twenty-two examines the macroeconomics problems of developing countries and the repercussion of those problems on the developed world.

In summary, we live in the era of rapid technological change in both public and private sectors. More often than ever before, decision-makers are called upon to apply economic analysis to challenging problems. It is not enough for decision-makers to have a firm grasp of economic theory; he/she must be able to apply the theory in a practical way to real problems. In these circumstances, the objective of this text is not only to provide the theory of international trade and monetary economics but also to bridge the gap between economic theory and practical application. The bridge has been constructed on a solid base of international trade and monetary theory with appropriate diagrams, using a blend of quantitative methods, case studies and good illustrative examples.

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