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An Economic Analysis Of Demand For And Supply Of Rice In Nepal

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1 Introduction :

Nepalese agriculture is in the process of transforming from its traditional to a modern one. Several economic and social constraints are slowing down the modernization process. The slow process in the development of the agricultural sector has raised several issues regarding the future foodgrain situation in the country. This study which refers to rice which has been considered the staple diet of the Nepalese and an important commodity contributing to the Nepalese economy, has great relevancy because of the present growing population. Rice covers more than 60 percent of the land under cultivation, accounts for the highest output among agricultural crops, and provides employment opportunities for the majority of the farm people. It accounts for more than 6o percent of the total value of exports and serves as an important source of government revenue and foreign exchange.

The 1971 Nepal population census reported a 2.07 percent annual population growth and estimates a 2.18 percent growth from 1975-76 to 1980-81. An equal or greater population growth rate may continue from 1980-81 possibly because of a high level of illiteracy and a subsistance level economy.

The growing population with a moderate income growth needs an increasing rice supply or it may put an upward pressure on rice prices. Whether the country is able to produce

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enough rice to meet the potential demand for rice and stabilise prices is a crucial issue for the country. The paper intends to evaluate production and consumption potential with respect to rice. It projects the likely demand for and supply of rice and influences on price situations on a long term basis. This study may help policy makers and planners understand the existing rice situation, and identify and define future policy options regarding rice within a long range framework.

2. Supply Situation :

Present Supply Situation :

The total foodgrain output growth[1] for the last thirteen year period (1964/65–1975/76) was 1.49 percent a year and total acrease growth was 1.90 percent a year. Paddy, wheat, and millet output increased by 1.32, 9.07 and 4.04 percent a year due to an increase in acrease. The acrease increase for paddy, wheat and millet was 1.15, 10.11, and 2.41 percent per annum respectively. Paddy yield did not increase significantly while wheat snd millet yield decreased by 0.97, and 1.14 percent a year. Maize and barley acrease increased by 0.3 and 0.38 percent a year, but their output decreased by 0.97 and 1.14 percent a year mainly due to yield decrease at 0.46 and 1.37 percent a year. The rice output growth during the period under study has relatively low due to its insignificant yield increase (Tables 1,2,3).

Supply Projection :

A reasonably reliable long-term supply projection is not possible without accessibility to more data inputs. Weather is a major factor determining supply situations in a country like Nepal, where more than 3/4th of land is deprived of irrigation facilities. This study makes

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1 Annual growth rate is calculated by using semilog transformation : $y=abt$, $b=1+g$, where y=production=acrease=yield, t=year, g=annual growth rate. Estimating equation : $\ln y=\ln a+t\ln b$ or $\hat{y} = \hat{a} + \hat{b}t$, where $\hat{y}=\log y$, $\hat{a}=\log a$, $\hat{b}=\log b$. The regression yields estimates of $\hat{a}$ and $\hat{b}$; $\hat{b}$ = antilog $\hat{b}$, $\hat{g}=\hat{b}-1$ (For more detail see J. Jonston, **Econometric Methods**, 2nd ed. (1972), pp 47–50. The data source for the analysis is **Agricultural Statistics of Nepal (1977)**, His Majesty's Government, Department of Food and Agricultural Marketing Services, Kathmandu, Nepal.

two supply projections-low and medium (Table 4). Low supply projection is a trend based approach which is a common method used by FAO studies to avoid unpredictable complexities. Medium supply projection assumes a reasonably high growth rate of rice production in relation to the past growth rates. These assumptions are contigent upon the government's top priority to rice growing due to its significant role in domestic earnings and feeding the population. Also, favourable weather conditions are assumed to prevail throughout the projected period.

3. Demand Situation :

Present consumption Trend :

Total consumption in the study is equated with total domestic availability of supply of cereal grains, since there are not data available on stocks, and storage capacity is limited. A semi linear trend[2] fitted with per capita food grain consumption using the time series data (1964/65–1974/75) shows that the consumption of rice, wheat, and millet increased by 0.82, 6.64 and 1.74 percent a year, respectively, while maize and barley consumption decreased by 2.59 and 3.17 percent a year. This indicates that there has been significant increase in wheat and millet consumption with small increase in rice consumption. Maize and barley consumption has decreased significantly (Table-5).

Demand Projection :

This involves two basic variables--population and income, assuming all prices remain constant. Income elasticity estimated from an econometric model[3] is used for demand

2 The semi- linear trend is expressed : $y=a+b \log t$, where y=per capita consumption, a=constant, b=coefficient, and is estimated as in 1.

3 The statistical model developed is a simultaneous equation model :

I $QCDNt = f\ (^{P}RN_{t,}\ ^{P}MN_{t,}\ ^{Y}N_{t})$ _____ Domestic Demand Function

II $^{Q}DENt = f\ (^{P}RNt,\ ^{I}RP_{t})$ _____ Export Demand Function

III $^{Q}TUt = {}^{Q}CDN_{t} + {}^{Q}DEN_{t}$ _____ Total Utilization Identity

where,

QCDNt = total domestic consumption of rice in year t (in 1,000 metric tons)

^{Q}DENt = total domestic export of rice in year t (in 1,000 metric tons)

projection.[4] The income elasticity derived from the model is close to the ones estimated by Pant and Jain (1972) and FAO studies (1971).[5] Three demand projections have been made in this study (Table-6).

Q_{TUt} = total utilization of rice in year t (in 1,000 metric tons)

PRN_t = retail price of rice in year t (in Rupees/kilogram)

PMN_t = retail price of maize in year t (in Rupees/kilogram)

YN_t = total national gross domestic product in year t (as a proxy variable of aggregate income in million rupees)

IRP_t = total rice production in India (in 1,000 metric tons)

The, estimated elasticities by the simultaneous logarithm functions are:

$$QCDN_t = 3.902 - 0.165^{*} PRN_t + 0.080\ PMN_t + 0.373^{***} YN_t$$
$$(0.148) \qquad (0.142) \qquad (0.171)$$

$$QDEN_t = 4.675 - 0.187\ PRN_t - 0.875^{**} IRP_t$$
$$(0.256) \qquad (0.728)$$

The numbers in parenthese are standard errors

* Significant at the 85 percent confidence level

** significance at the 90 percent confidence level

*** significance at the 95 percent confidence level

See for more detail Tulachan, Pradeep M. Production and Demand For Rice : The past Situation and Future Prospect, M. S. Thesis submitted to The Graduate School, University of Illinois, U. S. A., 1979.

4 The following statistical tools are used to estimate the annual aggregate demand for rice : To estimate annual growth rates of demand : $D = P + e.g.$ where D = annual growth rates of demand for rice, P = annual growth rate of population, g = annual growth rate of aggregate income, e = income elasticity of demand for rice, to estimate the total quantity demanded for rice annually: $Q = Q(1+D)^{n}$, where Q = total quantity demanded for rice, D = annual growth rate of demand for rice, n = number of years.

5 The income elasticity derived by the model in 3 is 0.373 which is close to income elasticities of rice 0.356 (Pant and Jain 1972) and 0.30 (FAO 1971). See Pant, Y. P. and Jain, S. C., Long Term Planning for Agriculture in Nepal, Vikas Publication, Indla, 1972 and FAO Agricultural Commodity Projections 1970-80, Volume I, II, FAO, Rome, 1971.

Demand I: This is estimated based upon two assumptions :

1. the past and present population growth trend will remain the same and,

2, the aggregate income growth will be four percent a year.[6]

Demand II It is estimated based upon two assumptions :

1. a declining population growth,[7] and
2. extrapolated aggregate income figures.[8]

Demand III. It is estimated based upon two explicit assumptions :

1. a decline population growth rates and
2. four percent a year aggregate income growth.

4. The Supply and Demand Balance :

The two projected supply of and three projected demand for rice scenariors are examined in different combinations. Under all circumstances except the high supply – low demand situation, the nation is likely to face a rice shortage situation at constant prices beginning in 1980's. The degree of rice shortage varies on alternate demand and supply situation as indicated in Table – 7·

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6 The National Planning commission has estimated an aggregate income growth rate at 4 percent a year at current factor prices, and it is assumed that this will continue for the next thirty five years. See Gorkhapatra,April 5, 1979.

7 Several studies have shown that there has been a declining trend of world-wide population growth rates. According to the population projections made by the community and family study center (CFSC), World Bank, United Nations, and U. S. census Bureau for Asia, a future decline in Asian population growth rates of between 2.11 to 1.84 percent for the period 1980 through 1985, and of between 1.8 and 1.36 percent for the period between 1995 and 2000 has been estimated. See Tsui, Amy ong and Bogue, Donald J., Declining World Fertility : Trends, Causes, Implications, Population Bulletin, a publication of the population reference bureau, Inc. Vol. 33 No. 4, october, 1978.

8 An analysis of time series data on national gross domestic product (1961–75) at current factor prices provides an annual income growth rate of 5.4 percent. The Analysis method is the same as discussed in 1.

5. The Influence of Supply and Demand Balance on Rice Prices :

The rice shortage situation reflects in its prices. Those people who can afford high prices continue to avail rice in a very short situation. Price can be taken as an indicator of supply and demand situation resulting into either deficiet or surplus situation. Three hypothetical ricc price changes have been estimated[9] with two ricesupply and three demand situations (Table-8).

9 The price change rates have been ealculated by using the formula: Pr = (Q – D)/e, where Pr = annual growth rate (or changes of rice prices) Q = annual gaowth rate of rice supply, D = annual growth rate of rice demand, and e = price elasticity of rice.

Conceptually, the percent change in price is the product of the difference between percentage change in quantity supplied (Qs). This is the price flexibility of demand which is defined as percentage change in price of a commodity in response to a one percent change in quantity demanded of that commodity. It can be illustrated diagramatically with an assumption of perfectly inelastic supply curve. As shown in figure 1.0, Po is the equilibrium price when demand is DD and supply is S. When the demand curve DD shifts to D' D', an increase in quantity demanded will be Q3 -Q1 at the equilibrium price Po. However, if supply increases by small amount (S to S') compared to the demand shift, the quantity of supply increase will be only Q2 – Q1. At this given level of supply change, the new equibrium price will be p1. Since, $Q_3 - Q_1$ is the change in demand, and $Q_2 - Q_1$ the change in supply, Q – D becomes $(Q_2 - Q_1) - (Q_3 - Q_1) = Q_2 - Q_3$ which is a negative number indicating demand has shifted farther than supply. This negative number (in percent terms) is the percent change in quantity. When divided by the coefficient of price elasticity of demand, the percentage change in price is derived. This method, in assuming a completely inelastic supply function, will tend to overstate the resulting price increases over what would occur if the supply function were assumed to have a positive price elasticity.

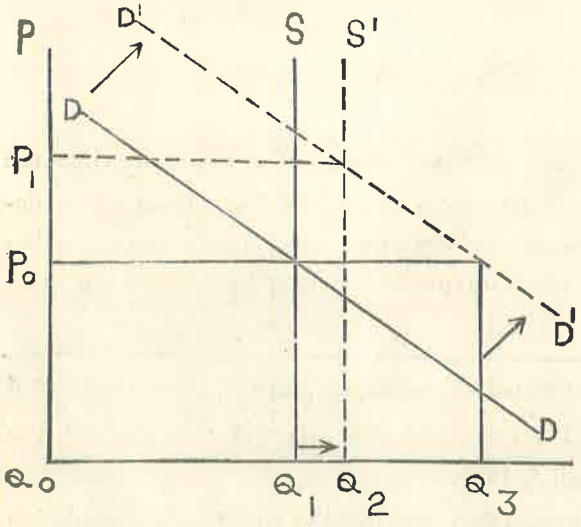

Figure 1.0

The influences of export or import are assumed to have no effects. As shown in the table the medium supply-demand situation would result in positive price changes from 1980 through 2010 because of the more rapid increase in demand than supply. Thereafter, rice prices would tend to level out through 2015. Nevertheless, the low supply-demand II situation would result in strongly rising prices for 1980 through 2015, but at a decreasing rate, under the medium supply-demand III circumstance, increasing price changes would be observed until 1995. Thereafter, a declining relative price situation would be experienced.

6. Implications and conclusions :

The projected rice supply and demand are estimates based on some reasonably defined assumptions. The annual growth rates of rice production assumed in the supply projection are relatively high compared to its past growth rates of output and yield. Even under these relatively high growth rate assumptions for rice production, and constantly declining population growth rate, future domestic demand for rice seems to exceed the supply at the constant prices due to income and population effects. In these "shortage situations" rice prices tend to increase to equate quantities demanded and supplied.

The projected rice supply and demand balances do indicate that Nepal may soon face rapidly increasing rice prices, and a reduced export surplus of rice. This may last for 20 to 30 years or longer unless supplies of rice can be increased substantially faster than in the past. This is a serious problem since rice constitutes an important part of the diet for all income levels in many regions. If export surpluses are reduced significantly, foreign exchange shortages will become even more serious in the future than at present. However, rapid price increase of rice could very likely lead People to change their consumption patterns. They might substitute cheaper sources of calories like wheat, maize, barley, millet, and potato for rice. This might lessen the projected rising price situations of rice to some extente. A more elastic supply response to rising prices would also tend to mitigate the projected price increases pointed out in this study.

Table - 1 : Annual Growth Rate of Cereal Production, 1964/65- 1976/77

S. No	Crop	Intercept	Coefficient	Annual Linear Growth Rate	R^2
1.	Paddy	7.7235	0.0132*	1.32	0.45
		(0.01655)	(0.00442)		
2.	Maize	6.6875	-0.00389+	-0.39	0.10
		(0.01318)	(0.00352)		
3.	Wheat	5.4688	0.08681*	9.07	0.89
		(0.03455)	(0.00924)		
4.	Barley	5.5178	-0.010015**	-0.99	0.19
		(0.02347)	(0.00627)		
5.	Millet	4.8086	0.03962*	4.04	0.52
		(0.04292)	(0.01147)		
6.	Total out put of cereal grains	8.15003 (0.01051)	0.01477* (0.00281)	1.49	0.72

Table - 2 : Annual Growth Rates of Cereal Acreage, 1964/65-1976/77

S. No	Crop	Intercept	Coefficient	Annual Linear Growth Rate	R^2
1.	Paddy	7.07025	0.01143*	1.15	0.86
		(0.005232)	(0.00139)		
2.	Maize	6.09020	0.003172**	0.30	0.17
		(0.007917)	(0.00212)		
3.	Wheat	5.3558	0.09626*	10.11	0.91
		(0.0346)	(0.00925)		
4.	Barley	5.5772	0.003798	0.38	0.10
		(0.01335)	(0.003568)		
5.	Millet	4.7225	0.002379	2.41	0.93
		(0,007627)	(0.002038)		
6.	Total Acreage under cereal grains	7.59072 (0.00359	0.01880* (0.00096)	1.90	0.97

Standard errors are in parentheses.

* Significant at 99 percent confidence level

** Significant at 90 percent confidence level

\+ Significant at 80 percent confdence level

Table-3: Annual Growth Rates of Cereal Grains Yields, 1964/65–1976/77

S. No.	Crop	Intercept	Coefficient	Annual Linear Growth Rate	R^2
1.	Paddy	0.6530	0.00164	0.16	0.21
		(0.01279)	(0.00342)		
2.	Maize	0.6018	-0.00460+	-0.46	0.18
		(0.01121)	(0.00301)		
3.	Wheat	0.010488	-0.009726+	-0.97	0.18
		(0.03418)	(0.009134)		
4.	Barley	-0.010448	-0.01376*	-1.37	0.48
		(0.00163)	(0.00435)		
5.	Millet	0.1568	-0.01149**	-1.14	0.10
		(0.02069)	(0.00553)		

Table-4: Trends in Annual Consumption of Cereal Grains, 1964—1976

S. No.	Crop	Intercept	Coefficient	Annual Linear Growth Rate	R^2
1.	Paddy	4.77021	0.008197**	0.82	0.21
		(0.01809)	(0.00483)		
2.	Maize	4.26773	-0.02628*	-2.59	0.85
		(0.01237)	(0.00331)		
3.	Wheat	3.0503	0.06431*	6.64	0.80
		(0.03647)	(0.00975)		
4.	Barley	0.79566	-0.03225*	-3.17	0.73
		(0.02238)	(0.00598)		
5.	Millet	2.3887	0.017315*	1.75	0.17
		(0.04379)	(0.01170)		

Standard errors are in parentheses.

* Significant at 99 percent confidence level

** Significant at 90 percent confidence level

\+ Significant at 80 percent Confidence level

Table-5: Supply Projection of Rice, 1980–2015

Year	Low Supply Extrapolated Production (1.000 Metric Tons)	Medium Supply Production Growth Rates (percent)	Medium Supply Aggregate (1.000 Metric tons)
1980	1883	2.00	1916
1985	2010	2.25	2141
1990	2147	2.50	2422
1995	2292	2.75	2774
2000	2448	3.00	3216
2005	2615	3.25	3774
2010	2792	3.50	4482
2015	2982	3.75	5388

Table-6: Projections of Demand for Rice at Constant Prices Under Different Annual Income and Population Growth Rate Assumptions, 1980–2015.

	Growth Rates									Total Rice Demand		
	Population			Income			Rice Demand			D_i	Dii	$D_{i\,ii}$
Year	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
1980	2.15	2.1	2.1	4.0	5.4	4.0	3.64	4.11	3.59	1888	1931	1884
1985	2.15	1.9	1.9	4.0	5.4	4.0	3.64	3.91	3.39	2257	2340	2225
1990	2.15	1.7	1.7	4.0	5.4	4.0	3.64	3.71	3.19	2699	2807	2603
1995	2.15	1.5	1.5	4.0	5.4	4.0	3.64	3.51	2.99	3228	3335	3017
2000	2.15	1.3	1.3	4.0	5.4	4.0	3.64	3.31	2.79	3859	3925	3462
2005	2.15	1.2	1.2	4.0	5.4	4.0	3.64	3.21	2.69	4614	4597	3953
2010	2.15	1.0	1.0	4.0	5.4	4.0	3.64	3.01	2.49	5517	5332	4470
2015	2.15	1.0	1.0	4.0	5.4	4.0	3.64	3.01	2.49	6597	6184	5055

Income elasticity for all projected years is 0.373

Total Rice Demand is reported in 1,000 metric tons.

Table-7: Differences in Rice Demand and Supply Projections, 1980–2015

(in 1,000 metric tons)

Year	$S_M - D_I$	$S_M - D_{II}$	$S_M - D_{III}$	$S_L - D_I$	$S_L - D_{II}$	$S_L - D_{III}$
1980	+28	-16	+32	-5	-49	1
1985	-177	-199	-84	-247	-329	-215
1990	-277	-385	-181	-552	-660	-456
1995	-453	-561	-243	-935	-1043	-724
2000	-643	-709	-246	-1410	-1477	-1060
2005	-841	-823	-179	-2000	-1982	-1338
2010	-1035	-850	+12	-2725	-2539	-1678
2015	-1210	-796	+333	-3616	-3202	-2073

S_M=Medium supply, S_L -Low Supply, D_I =Demand I, D_{II} =Demand II and D_{III}= Demand III

Table-8: The Effect of Different Annual Growth Rates in Rice Supply (Production) Upon the Demand for Rice and Its Prices with Various Hypothetical (Assumptions, 1980–2015).

	Growth Rates in		Growth Rates in			Hypothetical Assumptions				
Year	L_S	M_S	D_I	D_{II}	D_{III}	n	e	MS,D_I	MS,D_{II}	MS,D_{III}
1980	1.32	2.0	3.64	4.11	3.54	0.373	-0.165	10	17	10
1985	1.32	2.25	3.64	3.91	3.39	0.373	-0.165	8	16	7
1990	1.32	2.50	3.64	3.71	3.19	0.373	-0.165	7	14	4
1995	1.32	2.75	3.64	3.51	2.99	0.373	-0.165	5	13	2
2000	1.32	3.00	3.64	3.31	2.79	0.373	-0.165	4	12	-1
2005	1.32	3.25	3.64	3.21	2.69	0.373	-0.165	2	11	-3
2010	1.32	3.50	3.64	3.01	2.49	0.373	-0.165	1	10	-6
2015	1.32	3.75	3.64	3.01	2.49	0.373	-0.165	-1	10	-8

LS=Low supply, MS=Medium supply, D_I =Demand I, D_{II} =Demand II

D_{III}= Demand III, n=Income Elasticity of Demand for Rice

e=Price Elasticity of Demand for Rice.