LOWERING THE COST OF HIGH-VALUE AGRICULTURAL COMMODITIES

A MARD Policy Study

MARD/Lumbini-Gandaki Technical Report No. 41

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LOWERING THE COST OF HIGH-VALUE AGRICULTURAL COMMODITIES

A. Introduction

A1. The Importance of Lowering the Cost of Food

If Nepal is to be successful in sharply reducing poverty over the next decade, its agricultural policies will have to ensure a reliable supply of food at moderate cost, while commercializing agriculture. This process will reduce the share of disposable income spent on food, and thus allow greater shares of household budgets to be spent on non-food goods. Commercialization of agriculture will increase the productivity of land and those workers remaining in agriculture, while the remaining rural labor supply is increasingly attracted by higher non-agricultural wages. Without increased resource productivity, domestically produced foods will continue to be more expensive at the border, and farmers will not earn enough income to buy non-food goods. Those farmers who stay in agriculture will have to be compensated for lower food prices with incomes that are competitive with non-agricultural wages[1].

The Agricultural Perspective Plan[2] (APP) seeks to accelerate agricultural growth through the introduction of improved technologies and public investments in infrastructure that is highly complementary with agriculture. The APP, as well as the MARD project, is concerned with exploiting presumed market opportunities in the so-called "high-value" commodities. A previous MARD policy study assessed the options for introducing sustainable technical change in agriculture[3]. However, the technology strategy defined in the APP has not been reconciled with frequent public pronouncements about either the need to increase agricultural exports or the anticipated imminent surge in such exports, and the reality of the markets faced by Nepal's farmers.

A2. Purpose of This Report

This report examines the role of production and marketing costs in realigning Nepal's high-value agricultural commodity sector with the reality of declining real prices for those products. Farm prices and yields are compared with market trends to highlight the importance of reducing production and marketing costs if these products are to be

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1 The definitive explanation of agriculture's role in the economic development process is found in the writings of John Mellor, which are conveniently recapitulated, along with important country studies, in: John W. Mellor (ed.) *Agriculture on the Road to Industrialization*, Baltimore, MD: Johns Hopkins University Press, 1995.

2 Agricultural Projects Services Centre (APROSC) and John Mellor Associates, Inc. *Nepal Agricultural Perspective Plan*. Final Report - Main Document, prepared for National Planning Commission, His Majesty's Government of Nepal, and Asian Development Bank, June 1995.

3 Larry C. Morgan. *Accelerating Technical Change in Agriculture*, MARD/Lumbini-Gandaki Technical Report No. 40, June 1999.

competitive with India and help reduce the food share of household budgets. But if prices fall to more competitive ranges, farmers and traders will have to use their resources much more efficiently. Whether they adopt improved production and marketing technologies will largely be determined by the extent to which increased market volumes more than offset declining real prices.

A3. Organization of the Report

The cost-price policy problem is addressed in three parts. Section B examines trends in the supply and demand of high-value commodities to clarify the market situation farmers and traders face in becoming more competitive. Section C examines the options for reducing production and marketing costs. Finally, section D draws conclusions from the findings and makes recommendations on actions to lower high-value commodity prices, with special reference to the interventions being implemented by the MARD TA Team in the Lumbini-Gandaki zone.

B. Trends in the Supply and Demand of High-Value Commodities

Over the last two decades, "high-value" commodity development programs have become staple interventions in developing countries, primarily because of they are compatible with "trade and development" strategies and hold great promise for addressing traditional agricultural stagnation issues [4]. HVCs are popular because they yield high returns to labor, and require larger amounts of presumably underemployed or unemployed rural labor. HVC production can be "jump-started" by introducing existing "off the shelf" technologies from developed and rapidly developing countries, which in turn become potentially lucrative HVC import markets. Unfortunately, these justifications for HVC programs often give too little attention to the full implications of "high-value." Just as financial instruments with unusually high yields also carry a proportionately higher risk, HVCs have relatively high risks. Thus, the high labor returns of HVCs often serve as a proxy for the risks of greater post-harvest losses, local labor supply constraints, new IPM problems, and longer-term doubts about the adaptability of international technology to local agro-climatic conditions.

In the case of Nepal, these risks are compounded by substantial Indian HVC imports, which are rarely mentioned in public pronouncements about optimistic prospects for exporting Nepalese HVCs to India. Potato, cauliflower, cabbage, and tomato (PCCTs) were selected as the HV crops with the greatest potential for market expansion because they already have major market shares in the MARD/Lumbini-Gandaki pockets (Annex A), their yields are far below commercial standards, and they have major shares in the Butwal wholesale horticultural market (Table 1). Poultry (chicken eggs and meat) and piggery (pork) were selected as the livestock enterprises that have the greatest potential for growth during

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[4] Nurul Islam. *Horticultural Exports of Developing Countries: Past Performances, Future Prospects and Policy Issues.* IFPRI Research Report No. 80; Washington, DC: International Food Policy Research Institute, 1990.

the life of the MARD project. Trends in these markets reveal a slow long-term decline in real prices against rising market volume.

B1. Sources of Supply

During 1996-1997, estimated fruit and vegetable production in Nepal was 1.79 million tons, while fruit and vegetable imports from India were estimated at a border value of Rs 449 billion[5]. There are no national estimates on the proportion of HVC production that is marketed. The MARD/Lumbini-Gandaki benchmark surveys for 1998 estimated 44 percent of the HVC production in the 6 MARD districts was marketed. If this ratio were applicable to the entire country, it would mean that about 780,000 tons of fruits and vegetables were marketed from domestic production.

While there are no estimates about how much of the nation's production enters the major regional and central wholesale markets, there are some estimates about how much of that volume is imported from India. Traders estimated that more than 75 percent of the volume traded in the Butwal wholesale horticultural market during 1997-1998, or at least 38 thousand tons, was imported from India (Table 1.) In the Kathmandu Kalimanti wholesale market, about 8,800 tons, or about 21 percent of the annual PCCT volume was imported during 1998-99. The country of origin is not reported, but practically all of these commodities were shipped from India. These volumes strongly suggest that Indian imports are a substantial component of Nepal's wholesale horticultural market, and that official import statistics are seriously undervalued[6].

Table 1. Butwal Wholesale Horticulture Market Volume, 1997/1998

Commodity	Average Price (Rs/Kg)	Annual Volume (MT)	Total Value (Rs)
Potato	**10.65**	**22,770**	**242,500,500**
Onion	35.00	6,093	213,255,000
Apple	30.00	3,000	90,000,000
Tomato	**15.64**	**5,550**	**86,802,000**
Mango	30.00	1,800	54,000,000
Cauliflower	**19.25**	**1,989**	**38,288,250**
Cabbage	**7.69**	**4,834**	**37,173,460**
Chili (Green)	25.00	851	21,275,000
French Bean	15.50	765	11,857,500
Garlic	20.00	480	9,600,000
Banana	8.00	1,095	8,760,000
Radish	5.76	896	5,160,960
Orange	16.00	240	3,840,000
Ginger	12.00	120	1,440,000
Capsicum	18.29	39	713,310
Pineapple	5.00	120	600,000
Peas (Green)	N/A	140	0
Bottle Gourd	N/A	220	0
TOTAL	16.18	51,002	825,265,980

Source: James Diller, *An Action Plan for Development of the Butwal Horticultural Market*, MARD/Lumbini-Gandaki Technical Report No. 28, November 1998, Table 1, page 9.

[5] Agricultural Statistics Division. *Statistical Information on Nepalese Agriculture 1996/97*, His Majesty's Government, Ministry of Agriculture, Kathmandu, December 1997, pp. 2 and 97.

[6] Using table 1 as a crude estimate of import prices, if the Rs 449 billion in 1996-97 fruit and vegetable imports from India were valued at Rs 15 per kg, the volume would be about 30 thousand tons, which is far less than the imports believed to pass through Butwal and Kalimati. At a price of Rs 25 per kg, the volume

Imports of livestock commodities are even more difficult to estimate. However, it is well known that local markets in the terai regularly offer Indian eggs for sale. Like horticultural imports, it is widely believed that Indian egg imports play a major role in dampening price spikes that would otherwise occur from domestic seasonal declines in supply.

B2. Interpreting Trends in Real Prices and Marketed Quantities

Bajracharya, Shrestha and Walters (BSW) analyzed the demand behavior of the 7 HVCs[7] that have leading roles in the MARD/Lumbini-Gandaki market development strategy. Their analysis began by studying the trends in marketed quantities of each commodity (Table 2). Not surprisingly, they found that all trends were <u>positive</u>, with growth rates well above Nepal's population growth rate. Cauliflower, cabbage, and tomato quantities were recorded for the Kathmandu Kalimati wholesale market, and therefore include substantial amounts of Indian imports. Conversely, the quantities of potato, chicken eggs, chicken meat, and pork reflect only Nepalese production. If potato and chicken egg

Table 2. Annual Growth Rates in Major High-Value Commodity Markets

	Real Price		Quantity			
Commodity	Annual Growth Rate (%) [a]	P-value [b]	Annual Growth Rate (%) [a]	P-value [b]	Trend Q/P Elasticity [c]	Series/Market [d]
Potato	-0.8	0.34	7.6	0.00	-9.9	2041-2054 (national)
Cauliflower	-7.7	0.00	26.6	0.00	-3.5	2045-2054 (Kalimati)
Cabbage	-5.9	0.00	30.6	0.00	-5.1	2045-2054 (Kalimati)
Tomato	-0.4	0.83	14.9	0.01	-33.4	2045-2054 (Kalimati)
Chicken Eggs	-1.4	0.02	3.8	0.00	-2.6	2044-2054 (national)
Chicken	-1.4	0.02	5.1	0.00	-3.7	2044-2054 (national)
Pork	-0.0	0.99	3.5	0.00		2044-2054 (national)

SOURCE: Real price and quantity data are reported in: Ajaya N. Bajracharya, Madan G. Shrestha, and Forrest E. Walters. *MARD Market Information Program.* MARD/Lumbini-Gandaki Technical Report No. 31, February 1999, Statistical Annex, Section II – Price and Demand Analyses.

[a] Growth rate is estimated by the semi-log regression method, where Y (the natural logarithm of annual real price or quantity) is regressed on T (an index number for the data series), or: $Y = a + bT$. The regression coefficient (b) is the estimated average annual growth rate of (Y) over the data series.

[b] "P-Value" is the probability that the true value of the estimated annual growth rate (regression coefficient) is zero.

[c] Trend Q/P elasticity is the ratio of the trend quantity growth rate to the trend real price growth rate. It is an approximation of the price elasticity of the model "identified" by the raw data plot. All 7 commodities have negative price trends and positive quantity trends, so a demand relationship is "identified" for each commodity. See footnote 8 for the price elasticity calculation along a demand or supply curve.

[d] 2041 is 1984/85. 2044 is 1987/88. 2054 is 1997/98. National markets are retail; Kalimati market is wholesale.

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would be only about 18 thousand tons.

[7] Ajaya N. Bajracharya, Madan G. Shrestha, and Forrest E. Walters. *MARD Market Information Program*. MARD/Lumbini-Gandaki Technical Report No. 31, February 1999, Statistical Annex, Section II – Price and Demand Analyses.

quantities included Indian imports, those growth rates would likely be at least double the rates shown in table 2.

Next, BSW deflated nominal prices with the Nepal Consumer Price Index and found real prices to have negative, but relatively flat trends. This suggests that supply increased more rapidly than demand over the observed time period. If demand had increased faster than supply, observed market real prices and quantities would have tended to be more positively correlated. When the price and quantity trend for each commodity are compared, the raw data plots resemble a slightly negatively sloped curve. This usually means that over time, variation in the quantity suppled has exceeded variation in the quantity demanded. The data plotting resulting from such a pattern is said to "identify" a demand relationship.

With these real price-quantity relationships in mind, BSW specified a general demand model for each commodity as follows:

$$Qd = a + bRP + cRGDP + dDum1 \qquad [1]$$

where,

Qd	=	"quantity demanded" (total quantity marketed-produced or total quantity-produced per capita);
RP	=	"real price" (wholesale or retail, as noted, deflated by the Nepal CPI);
RGDP	=	"real gross development product" (GDP deflated by the Nepal CPI, as a proxy for disposable income);
Dum1	=	a dummy variable for large deviations in Qd (used in all models except pork); and
a,b,c,d	=	partial regression coefficents ("a" is the constant term, or the value of Qd when all independent variables, RP, RGDP, and Dum1, are zero).

The demand model results are summarized in Annex B. All of the estimated **RP** regression coefficients (**b**) are negative, as expected. Conversely, all of the estimated **RGDP** regression coefficients (**c**) are positive, as also expected. Thus all of the models predict that the quantity demanded varies inversely with price and directly with income. All of the models explain at least three-fourths of the variance in **Qd** except the chicken egg model (61 percent).

The estimated price elasticities measure the relative change in quantity due to a given percentage change in price[8] All of the demand equations are price inelastic except cabbage

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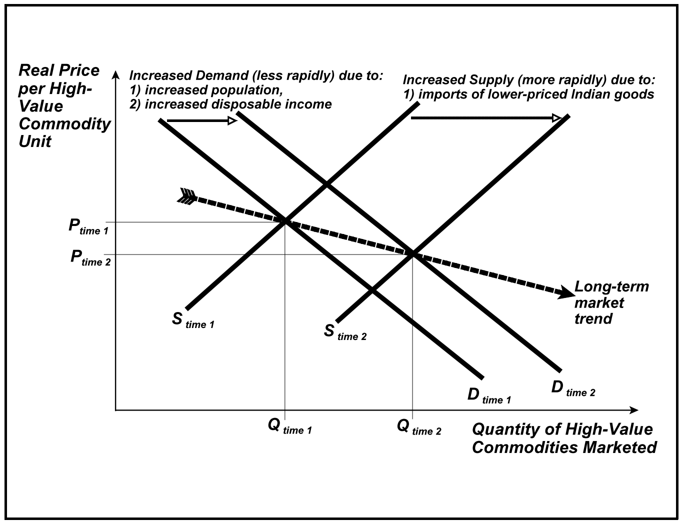
[8] The price elasticity of demand is the percentage change in quantity demanded per percentage change in price. At any given P,Q point on the demand curve, the instantaneous measure of price elasticity is: where $\frac{dQ}{dP}$ is the (inverse) slope of the demand curve, or (**b**) in Equation 1, and P,Q are respective price-

$$E_d = \frac{dQ}{dP}\frac{P}{Q} \quad ,$$

quantity points along the demand curve. Demand is price inelastic if the absolute value of E_d is less than one. For all absolute E_d values greater than one, demand is price elastic. If E_d is exactly -1.0, the demand relationship is unitary elastic, so that a given percentage change in price results in exactly the same percentage change in and chicken. Three points should be considered in applying these results to market development policy. First, the models using national data, particularly potato and chicken eggs, would tend to be more price elastic if Indian imports were included. This result would be caused by the larger **Q** for each observed **P**, thus stretching the **Q** axis to the right. The new curve would therefore be somewhat flatter, or more price elastic.

Second, the models estimated in annex B have some so-called "simultaneous equation bias" because supply equations were not estimated. The raw data plots for **RP** versus **Qd** are either flat or slightly negative in slope, like the arrow in exhibit 1. The demand shifter, **RGDP**, is a reasonable measure of the shifts between $D_{time\ 1}$ and $D_{time\ 2}$. **Dum1** helps explain some of the large shifts between $S_{time\ 1}$ and $S_{time\ 2}$, but it is not entirely satisfactory. BSW did not attempt to estimate the corresponding supply relationship for each commodity due to lack of convenient variables to serve as supply shifters, and the lack of time series for Indian imports. If those supply data were available, BSW could have used simultaneous equation estimation techniques to estimate the supply and demand curves for each commodity. It should now be apparent that such models would yield demand curves that are more price inelastic (steeper than the market trend arrow in exhibit 1) than the results reported in annex B.

Exhibit 1. Long-Term High-Value Commodity Market Trend



Finally, the conclusion that the "true" demand curves are likely to be more price inelastic thaN the results reported in annex B has important implications for market development policy. Sharp increases in supply would result in proportionally greater declines in price. Such market conditions would result in more economic welfare gains for Nepal's consumers, but farm income (**P**x**Q**) would decline after the supply increase because **P** would fall proportionally more than **Q** would increase. Under these circumstances, the long-term effects of market expansion would greatly benefit consumers, while putting heavy pressure on the less productive farmers to leave the sector, as predicted by John Mellor's model of agricultural industrialization. But in the near term, the more immediate question is how to improve farmers' land and labor productivity, and that means market development programs have to double and redouble efforts to lower the costs of production and marketing.

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quantity demanded, but in the opposite direction. The elasticity estimates in Annex A are at the means of P and Q for each model. MARD/Lumbini-Gandaki Technical Report No. 31. estimated the price elasticity and flexibility for each model. The price flexibility is the inverse of price elasticity, and more nearly describes the slope of the traditional demand curve where price is the dependent variable.

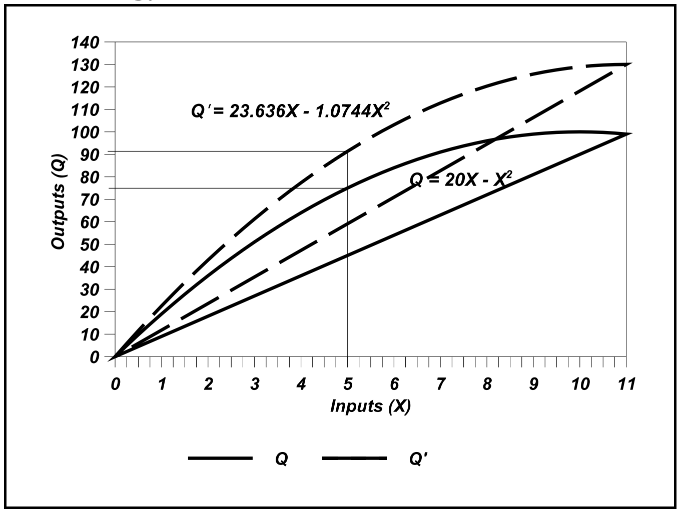
C. Options for Lowering Costs of High-Value Commodities

In an open, competitive economy, there are two fundamental options for lowering the cost of a good: improve the technology used in its production; and improve the efficiency of market services needed to supply the production inputs and transfer the good from the producer to the retail consumer. The APP is concentrated on the first option, for the practical reason that there is great potential for expanding production with improved technology as a "first generation" initiative, and many of the improvements in marketing efficiency take "second generation" precedence because large volumes are needed to make many marketing innovations cost-effective.

C1. Improved Production Technology

In MARD/Lumbini-Gandaki Technical Report No. 40, a simple production example is used to demonstrate the effects of improved technology. The production functions used in that example are shown in exhibit 2. The two production processes are quadratic functions. When the standard seed technology is used, grain production is maximized at 100 units when 10 units of fertilizer are applied (solid curve). But when improved seeds are used (dashed curve), grain production is maximized at 130 units when 11 units of fertilizer are applied[9]. If farmers adopt the new seed technology, the shift to the dashed production function in exhibit 2 would be equivalent to the shift from $S_{time\ 1}$ to $S_{time\ 2}$ in exhibit 1. The result is a lower market price and more marketed quantity. How this shift comes about is at the heart of many issues surrounding implementation of the APP.

Exhibit 2. Production Effects of Improved Technology



The vertical distance between the two production functions in exhibit 2 is the efficiency gain of the improved seed at each level of fertilizer used. But in exhibit 3 , the efficiency gain from the new technology is the vertical distance between the two supply

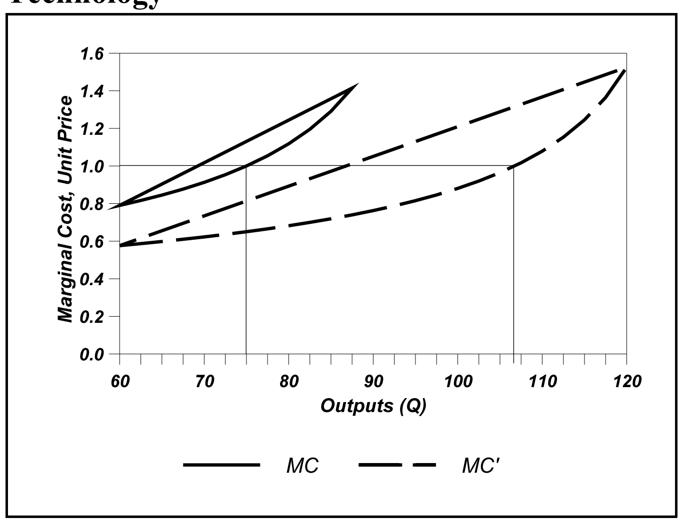
[9] Both functions have zero intercepts (originate at the intersection of the output and input axises) solely for convenience of illustration. In practice, some residual soil fertility would cause the estimated production functions to have positive intercepts. The simplest model would have the improved seed effect (dashed curve) represented at a uniform vertical distance above the unimproved function (solid curve) by means of a dummy variable (0 = unimproved seed; 1 = improved seed). The regression coefficient for the dummy variable would then measure the production effect of improved seed.

curves, which is a measure of the savings in fertilizer costs[10]. The supply curves are the schedules of output that the farmer will produce in response to alternative market prices. The level of production will be determined by the respective marginal cost that equals the market price.

A comparison between the production functions in exhibit 2 and the marginal cost/supply curves in exhibit 3 will demonstrate the market effects of this improved technology example. In exhibit 2, with 5 units of fertilizer, improved seed causes production to increase by 22 percent, from 75 to 91.3 units of grain.

In exhibit 3, the marginal cost of production with the original technology and 5 units of fertilizer is 1.0. But switching to improved seeds while still producing 75 units of grain results in marginal costs falling by 35 percent, to 0.65, because only 3.85 units of fertilizer are now needed to maintain the original level of production. If the farmer decides to spend as much on fertilizer with improved seeds as he did with unimproved seeds, the full market effect of the technology change is seen. Marginal costs remain at 1.0 (equal to the market price), but fertilizer usage increases to 6.35 units while production is increased by 43 percent, from 75 to 106.7 units. So, the causal effect of improved technology in this example is as follows: improved seeds cause marginal costs (at the original level of production) to fall by 35 percent, which then allows production to increase by 43 percent, while remaining competitive at the original market price. The adoption of the improved technology allows the farmer to increase his profit by using 1.35 extra units of fertilizer to produce 31.7 extra units of grain. Conversely, if the farmer chose to continue producing 75 units of grain, but with the improved technology, his profits would be less, but he would need only 3.85 units of fertilizer, and **MC'** would be only 0.65. If all grain farmers adopt the improved seed for grain production, the new industry grain supply curve is the horizontal

Exhibit 3. Supply Effects of Improved Technology



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[10] MARD/Lumbini-Gandaki Technical Report No. 40, *Accelerating Technical Change in Agriculture*, June 1999, explains how these curves are derived in Section B1 and Annex A. The equations for the production functions and marginal cost functions are as follows:

Production function:	
with traditional seed technology:	$Q = 20X - X^2$ (Q is grain output and X in fertilizer input)
with improved seed technology:	$Q' = 23.636X - 1.0744X^2$
Marginal physical product (MPP):	dQ/dX, or 20 - 2X for Q, and 23.636 - 2.1488X for Q'
Price of X is Px:	Px = 10
Marginal cost (MC):	Px/MPP, or 10/(20 -2X) for Q, and 10/(23.636 - 2.1488X) for Q'

summation of the **MC'** curve in exhibit 3 for each farmer, and would represent the shift from $S_{time\ 1}$ to $S_{time\ 2}$ in exhibit 1.

Improved technology at the farm level has an extra dimension that is not shown in exhibit 2. Risk and uncertainty typically cause farmers to adopt a new technology in two stages. In the first stage, the farmer gains experience raising productivity per production unit. For crops, this means increasing the yield per land unit. For livestock, output has to first be increased per brood animal, milk shed, or poultry house. Once the farmer is confident that the new technology will significantly increase output per production unit, as in exhibits 2 and 3, he will then consider expanding the number of production units of this commodity, so long as returns to his fixed resources are greater than in other enterprise options. In the case of crops, a farmer will typically try a new technology on a relatively small plot of land. Then, if the technology appears feasible, he will tend to divert more land to the new technology.

This two-stage adoption process is a prominent part of the MARD strategy. During 1998-99, over 400 on-farm crop demonstrations were conducted to diffuse improved crop production technologies. Many of the demonstrations were on potato, cauliflower, cabbage, and tomato (PCCTs) because these crops are the basis for key performance indicators in the MARD/Chemonics contract. How these yields compare to the break-even and benchmark yields will largely determine how enthusiastic farmers will be about adopting the MARD interventions during the next project year. The overall average OFD yield for the PCCTs was 39 tons per hectare, whereas the average break-even yield was 13 tons and the benchmark 1997-98 yield (without project assistance) was 6 tons (Annex C). These demonstrations were diffused throughout the 6 MARD/Lumbini-Gandaki pockets by:

1) conducting 80 crop on-site training programs for 2,106 farmers;
2) conducting 28 farmers field days for 1,211 participants;
3) supporting 82 farmer groups with 1,584 members; and
4) conducting 24 bottom-up planning workshops for 985 participants.

Results of the bottom-up planning workshops indicate widespread farmer knowledge about the OFDs, particularly for the PCCT crops. The consensus was that farmers are confident that the MARD crop interventions are much more beneficial than traditional production technologies.

Many farmers gained confidence with the interventions by carefully watching the OFDs in their pockets. Most of them have said they will use MARD interventions for the first time on their farms during the next season. Still other farmers copied MARD OFDs on their farms during 1998-99, and have said they will expand the cultivation of these crops during the next season.

The bottom-up planning workshops also revealed that farmers realize the price-depressing effects of Indian imports, and understand that their best hope for market expansion is to increase crop yields. They realize that Indian crops are exported to Nepal when local prices rise above Indian cost of production plus transportation cost to Nepal. By increasing yields, Lumini-Gandaki farmers see the opportunity to expand their share of the market by becoming competitive with the Indian import price. However, much of their new competitive advantage will be lost until overall marketing efficiency can be improved.

C2. Improved Marketing Efficiency

As value is added to goods and services as they move downstream from production input markets to final retail consumer markets, the cost of marketing services becomes a larger share of the final retail price. Much of the MARD market development program is focused on reducing post-harvest processing, storage, and distribution services for HVCs. Most project assistance in input markets is restricted to improving the supply of improved seeds.

C2a. HVC Markets

Marketing margins for priority HVCs in the MARD/Rupandehi pocket for 1998 are summarized in table 3 (Report no. 31 includes margin tables for all MARD pockets). These cost components provide the primary window for assessing which parts of the marketing chain hold the greatest potential for market development.

Table 3. High-Value Commodity Marketing Margins, Rupandehi District, 1998

Commodity	Production Costs for Commercial Farms	Cost-Price Margin	Estimated Farm Price	Handling, Packing & Processing	Transport Cost	Octroi & Other Costs 4%	Damage and Spoilage 2 to 10%	Commission 8%	Farm to Wholesale Margin	Wholesale Price	Retail Price
[a]	[b]	[c]	[d]	[e]	[f]	[g]	[h] & [m]		[i]	[j]	[k]
	---------- Nepal Rupees/Kg ----------										
Tomato	2.0	9.0	11.0	0.8	0.7	0.6	1.6	1.3	5.0	16.0	24.0
Cabbage	2.0	2.9	4.9	0.8	0.7	0.3	0.5	0.6	3.0	7.9	12.0
Cauliflower	3.0	11.4	14.4	0.8	0.7	0.8	1.4	1.6	5.2	19.6	23.5
Potato	3.0	0.6	3.6	0.8	0.7	0.2	0.3	0.5	2.5	6.1	9.0
Chick-meat	65.0	36.2	101.2	0.8	1.2	4.8	2.4	9.6	18.8	120.0	144.0
Eggs [l]	2.0	1.1	3.1	0.1	0.1	0.2	0.2	0.3	0.9	4.0	4.8
Pig Meat	59.0	23.3	82.3	0.8	1.2	3.9	2.0	7.8	15.7	98.0	117.6

SOURCE: MARD/Lumbini-Gandaki Technical Report No. 31, "MARD Market Information Program,", by Ajaya N. Bajracharya, Madan G. Shrestha, and Forrest E. Walters, Februay 1999, p. 57.

[a] Commodity selection is based on returns per labor day shown in MARD/Rapti Technical Report No.17, "The Definition and Role of High-Value Commodities in MARD/Rapti," by Larry Morgan, May 1998.

[b] Production costs based on individual budgets for each pocket. The format for cost estimation is shown in, "MARD/Rapti Crop Enterprise Budgets Data," by Luke Colaveto, June, 1998.

[c] Cost-Price Margin=Farm Gate Price-Production Costs

[d] Farm Gate Price = Wholesale Price-Farm to Wholesale Margin.

[e],[g] & [h] Based on direct observation by the MARD District Coordinator and MARD marketing staff

[f] Transport costs based on direct observation and information from Technical Report No. 20, Nepal Cross Border Agricultural Marketing Policy Study, Regional Agribusiness Project Development Alternatives, Inc., Jan., 1999.

[i] Farm to Wholesale Margin= Handle, packing & processing + transport cost + Octroi and other costs + Damaged and spoiled commodity

[j] Wholesale prices are spot prices reported to MARD Market Information System

[k] Retail prices are spot prices reported to the MARD Market Information System

[l] Egg costs are estimated on a "per egg" basis and not Kg.

[m] % Damage : Tomato, 10; Cabbage, 7; Cauliflower, 7; Radish, 5; Potato, 5; Chick-meat, 2; Eggs, 5; Pig meat, 2.

Farm costs and profits: The few commercial farmers are realizing large profits because they have production efficiencies of more than double the local norm. In the case of tomato production, commercial farmers stand to capture most or all of the "cost-price margin" of Rs 9 per kg. The MARD/Rupandehi tomato on-farm demonstrations clearly show the technical feasibility of using improved technologies to quadruple yields from 13 tons per hectare to 54 tons (Annex C).

Wholesale handling, packing and processing cost: Much of this cost is borne in recruiting small volumes from large areas on the periphery of the main wholesale market. In most cases, some of the farmer's "cost-price" margin is sacrificed in time and cost of transporting his produce to the nearest wholesale collection point. Until there is sufficient volume to justify produce wholesalers and brokers sending trucks into villages/pockets, farmers will have to absorb a significant part of the wholesale market consolidation cost. But in the interim before wholesalers and brokers have incentives to recruit at the village/pocket level, farmer groups can reduce their farm-to-market transportation and spoilage costs by forming group selling programs.

Wholesale transport cost: Like handling and packing costs, unit transportation costs vary inversely with volume. Brokers will consider sending a truck into a village/pocket when they are confident that they can load it quickly and recoup the trucking and handling costs. Otherwise, 50 to 200 farmers may transport the equivalent of one truck load of produce to local collection points by carrying baskets or riding bicycles, taxis, or buses, all of which greatly increase produce damage and spoilage losses.

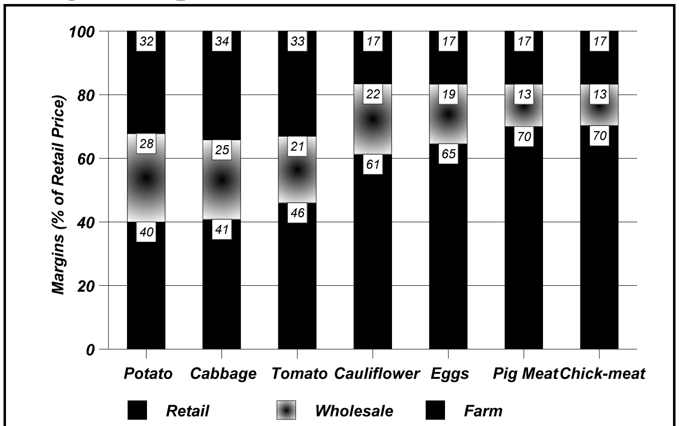
Wholesale Octroi and other costs: Farmers and traders are united in complaining about Octroi and other tax collection costs for agricultural produce. Unfortunately, this cost has to be considered as a fundamental limitation that is beyond the scope of market development programs. Until central and local governments improve tax policy, Octroi is an immutable cost to the marketing system.

Wholesale damage and spoilage costs: Produce damage and spoilage losses vary directly with farm-to-market distance, the amount of handling and repacking, and time lapsed since harvest. Increasing the volume available at the village/pocket level, through increased production and either wholesaler/broker recruitment or farmer group selling programs will create new incentives to reduce handling, improve packing, and reduce lapsed post-harvest time to market.

Wholesale commission costs: Wholesale and brokerage commission charges reflect the overhead costs of recruiting and selling produce. They include finance and carrying charges advanced to local agents and therefore represent the large capital cost of holding produce until it is sold. Lack of access to working capital often restricts the number of wholesalers in a particular market, and therefore reduces competitive pressures to reduce the discretionary portions of commission rates.

Farm-wholesale-retail margins: Exhibit 4 summarizes the marketing margin chain from the farm to the retail consumer. At each successive market level downstream from the farmgate, marketing costs add to the price that consumers ultimately pay. So, wholesale and retail supply curves are shaped by farm-level supply behavior, and their respective marketing margins are vertical additions to the farm supply curve. Table 3 can be put in better perspective by comparing it with exhibits 4 and 5. In exhibit 5, the standard farm-wholesale-retail margins from table 3 are stacked, to measure the relative vertical distances between the market supply curves in exhibit 4. These findings suggest the following conclusions and implications for HVC market development programs:

Exhibit 4. High-Value Commodity Marketing Margins, Rupandehi District, 1998

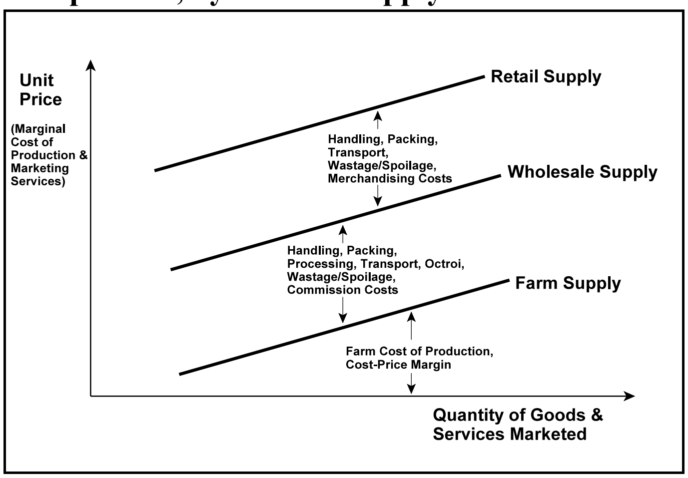


SOURCE: Ajaya N. Bajracharya, Madan G. Shrestha and Forrest N. Walters, MARD Market Information Program, MARD/Lumbini-Gandaki Technical Report No 31. February 1999, p. 57.

1) the farmer share of the consumer cost is greater for crops;
2) higher crop post-farm margins are a greater opportunity to lower costs;
3) the large wholesale potato margin includes intra-season storage and carrying costs; and
4) heavy imports of all 4 crops and eggs highlight India's competitive advantage in marketing, e.g., Pune/Maharasthra tomatoes sold in Butwal are equal or higher in quality than local tomatoes.

In all marketing cost situations, the importance of volume cannot be over-emphasized. Unit marketing costs in most rural areas are high because produce cannot be consolidated quickly to offer economies of size in transportation, handling, and brokerage services. This reinforces the MARD strategy of expanding production as a prerequisite for the marketing innovations needed to increase Nepal's competitiveness.

Exhibit 5. Production and Marketing Cost Components, by Market-Supply Level



C2b. Input Markets

Nepal's HVC prices will remain relatively high so long as the relevant input markets do not assure availability at prices that reflect their international opportunity costs. Currently, the seed and fertilizer markets are the main input constraints to lower HVC production costs.

Improved Seed: The shortage of improved seeds is the most important HVC production constraint. Most farmers are unaware of internationally available varieties that could easily double HVC yields. And even if farmers know these seeds, they are often not available from local agro-vets. Many agro-vets are not aware of local HVC improved seed marketing opportunities, and do not store seeds properly. Low seed germination, even among internationally supplied seeds, is a serious problem. In most cases, the cause of low germination can be traced to improper handling and storage post-factory, particularly by agro-vets failing to protect seeds from excessive heat and direct sunlight.

The MARD TA Team is addressing these issues by training HVC farmers in improved/hybrid varieties and training agro-vets in seed storage and marketing management. The Team has strengthened linkages between farmers and seed dealers by distributing a HVC seed input marketing directory[11] to MARD farmers groups and cooperatives, local agro-vets, and members of the Seed Entrepreneurs Association of Nepal (SEAN). The directory includes the names and addresses of farmers groups, cooperatives and agro-vets in MARD/Lumbini-Gandaki pockets as well as regional, national, and international seed dealers serving the project area. The directory also includes estimates of seed planting requirements in project pockets based on estimated cultivated crop areas during 1997-98, for recommended varieties. A short-term consultancy will develop group seed input buying programs to concentrate the volume of seed marketing business available to local agro-vets.

Fertilizer: The gains from improved seed availability would quickly be lost if fertilizer supply is not increased significantly. Indeed, all of the substantial donor assistance to improve crop productivity will be redundant if it is not complemented by an open, internationally competitive fertilizer market, regardless of the fertilizer price. The MARD on-farm HVC demonstrations have achieved high yields over the past year because the high productivity potential of improved/hybrid seeds was complemented with chemical fertilizer. Increased HVC production and sales will depend on: 1) adopting MARD technologies on the current land area cultivated in HVCs; and 2) expanding the land area cultivated in HVCs with MARD technologies. Neither of these HVC production changes will be sustainable without substantially larger fertilizer supplies.

The past public sector approaches to fertilizer have failed, as clearly acknowledged in the APP. What would be just as ineffective in the future would be further public marketing and subsidization of any chemical fertilizer. Supplies are unreliable, first because the Agricultural Input Corporation (AIC) is not being fully funded by HMG. But even if the AIC were fully funded, it lacks the profit incentive to manage its supplies to match farmers' demands. AIC advocates try to perpetuate the public sector's role in fertilizer marketing by pointing out the large amount of adulterated fertilizer imported from India each year. This

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[11] *MARD/Lumbini-Gandaki High-Value Crop Seed Input Marketing Directory*, MARD/Lumbini-Gandaki Technical Report No. 32, February 1999.

argument essentially justifies public sector usurpation of private sector market functions because the public sector cannot protect consumers from fraud and anti-competitive practices. These public sector arguments would justify the heavy cost of monopolies like the AIC as the cost of consumer protection. Nepal's HVC market would suffer the consequences of continued reduced and unreliable fertilizer supplies and higher fertilizer prices. The Treasury would continue to foot the bill for AIC's annual cost overruns and annual operating deficits.

The fertilizer problem is further complicated by a long history of subsidies. Their effect has not led to substantial increases in fertilizer usage, as may have been intended. Instead, commodity markets dependent on fertilizer have been further distorted and wholesale-farmer marketing margins have bulged. The APP strategy for subsidizing fertilizer distribution would further erode incentives to improve transportation efficiency.

Finally, as the fertilizer market has deteriorated, the declining supplies of unadulterated fertilizer have led to a growing market in adulterated fertilizers. Once farmers learn that the "fertilizer" they bought is fake, they have little recourse to local authorities, and less trust in the next fertilizer dealer's offer.

D. Options for Strengthening Nepal's Agricultural Price Policy

The APP strategy for accelerating agricultural development will have to operate in concert with market forces to lower the costs of high-value commodities. Recognizing the nature of the HVC marketing situation is the first step in coordinating pricing policies to make the APP a success. The programs required to lower the cost of HVCs will have to reflect the long-term roles that best suit the public and private sectors.

D1. A Summary of the HVC Marketing Situation

The MARD TA team is promoting production and market development initiatives in 4 high-value crops (potato, cauliflower, cabbage, and tomato) and 3 high-value livestock commodities (chicken eggs, chicken meat, and pork) because they have the highest potential for increased productivity and sales. The market trends and implications for these commodities can be summarized as follows:

1) real prices are falling slowly;
2) marketed quantities are increasing, generally faster than the population;
3) imports from India are a significant cause of this price-quantity trend;
4) commercial HVC producers will have to adopt improved technologies to remain competitive over time;
5) production and marketing costs will have to be lowered first to replace Indian imports before significant export markets can be established; and
6) local marketing margins are relatively high because low volumes do not generate economies in unit costs of marketing services.

D2. Programs to Lower the Cost of HVCs

The cost of HVCs will have to be lowered if the domestic food market is to be expanded and these commodities more fully utilize rural land and labor resources.. A secondary benefit would be opening new export markets for HVCs. MARD is designed to support this strategy, but such projects cannot bring about these changes alone. HMG has to mobilize its resources to exploit MARD-like projects if their interventions and achievements are to be sustained. The critical program areas for public initiatives in addition to the APP program are: a) tasking agricultural and livestock extension staff to conduct practical on-farm technology demonstrations in the vicinity of every agricultural service center; b) investing in local produce marketing infrastructure; c) privatizing all fertilizer marketing and eliminating all associated subsidies; d) protecting farmers from fraudulent sales of agricultural inputs and preventing anti-competitive practices in agricultural input and product markets; and e) rationalizing Nepal's trade regime by joining the World Trade Organization.

D2a. Demonstrate Improved Production Technologies

Several concrete steps can be taken to accelerate the adoption improved production technologies. The MARD on-farm high-value crop demonstrations have produced yields well above farmers' yields with traditional technologies. The MARD yields have also generally been at least 3 times greater than the breakeven yields required to cover the full production costs. During 1998-99, 438 crop OFDs were conducted at 72 sites (3 sites per VDC) throughout MARD pockets. During 1999-2000, 448 crop OFDs and 32 livestock OFDs will be conducted at 96 MARD sites. These interventions are being diffused effectively <u>within</u> MARD project areas.

HMG can expedite diffusion of MARD production technology interventions, by <u>saturating</u> non-project areas within each MARD district with:

1) similar OFD demonstrations under the auspices of the APP;
2) publicity and adaptive performance tests on internationally available high-value crop varieties;
3) farmers' field days and tours to demonstration sites;
4) brochures and leaflets that describe improved production technology packages to semi-literate farmers; and
5) public awareness campaigns that promote improved production technology packages.

D2b. Invest in Local Market Infrastructure

Haat bazaars are a major improvement in local produce marketing, but District and Village Development Committees still have great opportunities for reducing HVC consolidation and post-harvest losses. While haat bazaars provide a local market place for producers, traders and consumers, the sites are usually crowded and unsanitary. Market information is usually exchanged by word of mouth. Donor-funded projects are frequently requested to provide local market infrastructure. If the technologies were new, donor funding might be appropriate as a demonstration case. However, most of the technologies are well known and fungible through either district or village development funds or public-private partnerships[12].

HMG can expedite diffusion of MARD market development interventions, by saturating non-project areas within each MARD district with:

1) price information boards[13], installed and maintained by VDCs and agricultural service centers; and
2) market stalls and shades installed in haat bazaars to reduce congestion, spoilage, and handling costs.

D2c. Privatize Fertilizer Marketing

The AICs monopoly control of the fertilizer market has reduced supply and burdened HMG with large operating deficits. Because it markets other inputs besides fertilizer and has a large staff, it has broad political support in the face of regular calls for its privatization. Regardless of how HMG deals with AIC, it should reform the current fertilizer market by:

1) ending all government participation in fertilizer marketing; and
2) ending all transportation subsidies related to fertilizer.

D2d. Protect Consumers from Fraud and Anti-Competitive Practices

Past government domination of many tradeable goods and services industries has artificially raised prices and reduced marketed quantities, as would be expected of unregulated monopolies. Government has protected its industries against competition, but has not protected consumers from fraud. These policies have also raised prices and reduced marketed quantities in agricultural input and product markets.

HMG can lower the cost of agricultural inputs and products by:

1) enacting and enforcing standard consumer protection laws;
2) enacting and enforcing standard regulations on the manufacture and sale of feeds, seeds, agricultural chemicals, and veterinary medicines; and
3) enacting and enforcing standard antimonopoly laws.

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[12] See James Diller, *An Action Plan for Development of the Butwal Horticultural Market*, MARD/Lumbini-Gandaki Technical Report No. 28, November 1998, pp. 19-22, for a description of public-private partnerships, and how they could be used to renovate haat bazaars.

[13] See Ajaya N. Bajracharya , Madan G. Shrestha, and Forrest E. Walters, *MARD Market Information Program*. MARD/Lumbini-Gandaki Technical Report No. 31, February 1999, pp. 6-11, for a description of the price information boards installed by MARD and maintained by cooperators in each MARD pocket.

D2e. Join the World Trade Organization

Nepal's accession to the WTO is proceeding at a glacial pace. Until WTO membership is achieved, the country's economic system will not be aligned to exploit its competitive advantages in international markets and donors will not have an economic framework to fully exploit their assistance. HMG should rationalize its trade regime by undertaking a fast track WTO accession program. WTO membership would improve domestic market efficiency, and thus reduce prices and increase marketed quantities by requiring economic policies to support open and competitive markets. With its domestic markets aligned with international markets, Nepal would enjoy the benefit of WTO support when trading partners violate GATT/WTO trading rules.

Annex A – MARD/Lumbini-Gandaki High-Value Crop Production, 1998

HV Crop	Hectares	Tons	Yield (tons/ha)	Farm Price (rs/kg)	Production Value (Rs '000)	% of Production Marketed	Marketed Value (Rs '000)	Marketed Value Rank
MARD/Lumbini-Gandaki Project Pockets (24 VDC's in 6 Districts)[a]								
Ginger	135	1,400	10.37	13.70	19,164	79	15,147	1
Potato	**700**	**3,022**	**4.32**	**7.50**	**22,786**	**52**	**11,895**	**2**
Cauliflower	**156**	**1,463**	**9.37**	**10.80**	**15,864**	**73**	**11,634**	**3**
Tomato	**164**	**1,326**	**8.09**	**11.00**	**14,624**	**79**	**11,609**	**4**
Lentil	1,148	632	0.55	18.00	11,385	72	8,242	5
Mustard Seed	2,151	766	0.36	25.90	19,847	38	7,479	6
Cabbage	**102**	**1,070**	**10.52**	**7.10**	**7,636**	**76**	**5,829**	**7**
Banana	59	586	9.86	10.30	6,035	81	4,888	8
Orange	90	419	4.66	11.10	4,659	94	4,381	9
Brinjal	61	826	13.48	6.40	5,254	71	3,750	10
.....	.....	.....	.....	.....	.....	.....	.....	.....
Total HV Crops	6,108	17,653	2.89	10.10	177,608	62	110,745	
PCCT Total	**1,122**	**6,882**	**6.14**	**8.90**	**60,911**	**67**	**40,968**	
MARD/Lumbini-Gandaki Non-Project Areas in 6 Districts [b]								
Orange	174	3,730	21.48	7.60	28,176	88	24,670	1
Ginger	369	2,491	6.76	10.10	25,230	90	22,683	2
Mustard Seed	5,333	1,547	0.29	25.40	39,260	34	13,455	3
Lentil	1,497	935	0.62	19.50	18,208	47	8,519	4
Soybean	260	654	2.52	20.30	13,302	43	5,721	5
Gourd, ridge	42	342	8.12	15.80	5,411	87	4,685	6
Potato	**698**	**3,007**	**4.31**	**8.70**	**26,307**	**16**	**4,127**	**7**
Onion	159	818	5.13	15.70	12,821	24	3,134	8
Garlic	164	372	2.26	20.20	7,516	38	2,869	9
Cucumber	39	473	12.22	8.90	4,202	66	2,788	10
Tomato	**74**	**430**	**5.82**	**15.10**	**6,503**	**42**	**2,733**	**11**
Cauliflower	**122**	**525**	**4.29**	**11.20**	**5,875**	**43**	**2,526**	**12**
Colocasia	199	836	4.20	8.70	7,292	32	2,355	13
Banana	83	678	8.20	11.10	7,544	26	1,947	14
Cabbage	**102**	**565**	**5.54**	**7.00**	**3,974**	**46**	**1,824**	**15**
.....	.....	.....	.....	.....	.....	.....	.....	.....
Total HV Crops	10,917	25,260	2.31	10.60	267,637	44	118,604	
PCCT Total	**996**	**4,526**	**4.54**	**9.42**	**42,659**	**26**	**11,210**	
All 6 MARD/Lumbini-Gandaki Districts (Project and Non-Project Areas)								
Total HV Crops	17,026	42,913	2.31	10.60	445,245	44	229,349	
PCCT Total	**2,118**	**11,408**	**5.39**	**23.46**	**267,637**	**44**	**118,604**	

[a] *MARD/Lumbini-Gandaki Performance Benchmark Data for the Second Project Year, 1997-1998,* MARD/Lumbini-Gandaki Technical Report No. 26, November 1998.

[b] Special survey conducted by MARD/Chemonics for USAID/Nepal, February 1999.

Annex B – High-Value Commodity Demand Model Results

Variables: Dependent	Variables: Independent	Regression Coefficient	t Statistic [a]	P-value [b]	adj R^2 [c]	Series/Market [d]	Price Elasticity [e]
Potato	Intercept [f]	-19.496	-1.919	0.084	0.931	2041-2054	-0.340
(kg marketed per capita)	RP [g]	-4.363	-2.106	0.061		(national retail)	
	RGDP [h]	0.021	10.219	0.000			
	Dum1 [i]	5.493	4.232	0.002			
Cauliflower	Intercept [f]	-30,075,377	-2.350	0.057	0.979	2045-2054	-0.581
(kg marketed)	RP [g]	-678,573	-1.528	0.177		(Kalimati Wholesale)	
	RGDP [h]	11,511	3.600	0.011			
	Dum1 [i]	14,688,131	17.002	0.000			
Cabbage	Intercept [f]	-31,647,482	-1.035	0.341	0.752	2045-2054	-1.523
(kg marketed)	RP [g]	-3,289,936	-1.175	0.285		(Kalimati Wholesale)	
	RGDP [h]	13,447	1.811	0.120			
	Dum1 [i]	-5,765,218	-3.301	0.016			
Tomato	Intercept [f]	-37,397,955	-2.657	0.038	0.833	2045-2054	-0.197
(kg marketed)	RP [g]	-336,690	-0.493	0.640		(Kalimati Wholesale)	
	RGDP [h]	13,951	3.555	0.012			
	Dum1 [i]	8,333,800	4.976	0.003			
Chicken Eggs	Intercept [f]	22.629	2.481	0.042	0.611	2044-2054	-0.481
(eggs marketed per capita)	RP [g]	-7.673	-1.712	0.131		(national retail)	
	RGDP [h]	0.001	0.757	0.474			
	Dum1 [i]	2.002	3.440	0.011			
Chicken	Intercept [f]	0.953	2.009	0.084	0.742	2044-2054	-1.406
(kg marketed per capita)	RP [g]	-0.020	-2.340	0.052		(national retail)	
	RGDP [h]	0.000	0.602	0.566			
	Dum1 [i]	0.108	3.520	0.010			
Pork	Intercept [f]	0.420	6.929	0.000	0.768	2044-2054	-0.203
(kg marketed per capita)	RP [g]	-0.006	-3.357	0.010		(national retail)	
	RGDP [h]	0.000	4.889	0.001			

SOURCE: Ajaya N. Bajracharya, Madan G. Shrestha, and Forrest E. Walters. *MARD Market Information Program.* MARD/Lumbini-Gandaki Technical Report No. 31, February 1999, Statistical Annex, Section II – Price and Demand Analyses.

[a] Student's "t" statistic is the ratio of the estimated regression coefficient to it's standard error (not reported here).

[b] "P-Value" is the probability that the true value of the estimated regression coefficient is zero.

[c] Adjusted R^2 is the estimated proportion of total variance in the dependent variable that is explained by variation in the independent variables, after adjusting for degrees of freedom in the model.

[d] 2041-2054 is 1984/85-1997/98. "National" data use population to estimate demand (dependent variable on a per capita basis). "Kalimati wholesale" data are not measured on a per capita basis because that market serves more than the Kathmandu metropolitan area, but the exact population of that market is not known.

[e] Price elasticity is calculated at the means of the dependent variable and the price variable (RP). See footnote no. 8 for an explanation of price elasticity .

[f] The intercept is the constant term of the regression equation, or the estimated value of the dependent variable when all independent variables have zero values.

[g] Real price (RP) is the nominal average annual price (Rs/kg or Rs/egg), deflated by the Nepal Consumer Price Index, 1983/84 = 100. All prices are retail, except cauliflower, cabbage, and tomato.

[h] Real gross development product per capita (RGDP) is nominal annual GDP per capita, deflated by the Nepal Consumer Price Index, 1983/84 = 100.

[i] "Dum1" is a dummy variable, coded "1" or "-1" for large year-to-year deviations of the dependent variable from the trend, and otherwise coded "0". Non-zero values probably indicate unusually large shifts in supply.

Annex C – MARD Preliminary On-Farm Crop Demonstration Results, 1998-99

Pocket	Crop	On-Farm Demos (a)	BreakEven (b)	Benchmark (c)
		----------------- Yield (tons/hectare) -----------------		
Kapilbastu	Potato	27.2	13.0	0.5
	Cabbage	42.6	11.3	13.5
	Cauliflower	21.8	6.6	7.1
	Tomato	66.0	11.7	0.9
Rupandehi	Potato	27.1	13.7	3.7
	Cabbage	39.7	19.6	11.4
	Cauliflower	23.9	5.5	9.9
	Tomato	54.1	13.3	13.2
Nawalparasi	Potato	31.3	14.6	4.4
	Cabbage	70.5	30.8	10.2
	Cauliflower	29.4	8.4	9.8
	Tomato	74.7	19.9	9.7
Palpa	Potato	30.5	13.4	6.2
	Cabbage	34.4	19.6	4.6
	Cauliflower	13.7	8.3	5.9
	Tomato	64.5	24.4	9.0
Syangja	Potato	25.2	10.6	10.6
	Cabbage	30.4	10.7	8.7
	Cauliflower	11.1	6.8	8.9
	Tomato	(d)	8.7	3.0
Kaski	Potato	25.5	12.2	11.2
	Cabbage	18.1	14.2	19.4
	Cauliflower	17.6	6.4	15.5
	Tomato	(d)	5.1	15.0
All Pockets	Tomato	65.3	13.9	8.1
	Cabbage	44.2	17.7	10.5
	Cauliflower	20.0	7.0	9.4
	Potato	27.0	12.9	4.3
	All 4 crops	39.0	12.9	6.1

SOURCE: Larry C. Morgan. *Accelerating Technical Change in Agriculture*. MARD/Lumbini-Gandaki Technical Report No. 40, June 1999, p. 16.

(a) Yields are preliminary results from 265 plots as part of 438 on-farm demonstrations planned during the second MARD project year, 1998-99. All-pocket yields are weighted by the number of demonstrations per pocket.

(b) Breakeven yields are estimated as the yields required to cover the estimated cash costs of production, plus the imputed cost of required labor and finance charges, at estimated 1998-99 farm prices. The estimates per crop over all pockets are simple unweighted averages and are therefore not robust estimates of zone-wide breakeven yields for each crop.

(c) Benchmark yields are from *MARD/Lumbini-Gandaki Performance Benchmark Data for the Second Project Year, 1997-1998*, MARD/Lumbini-Gandaki Technical Report No. 26, November 1998. It should be noted that yields during 1997-98 were unusually low due to poor weather.

(d) Tomato on-farm demonstrations in Syangja and Kaski were destroyed by hail.