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Impact of Multilateral Agricultural Trade Liberalization on Household Welfare in Nepal

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1. Introduction

Today the Doha Round of Multilateral Trade Liberalization is at a crossroad. The thorniest issue that has thus far prevented an agreement concluding the negotiations is the highly distorted agriculture sector in the United States (US) and the European Union (EU) that protects their farmers through complex array of policies in terms of export subsidies and import tariffs as well as domestic support measures. G-3 to which South Asia belongs, have to ensure their demand for special protection which they have already secured for their most sensitive agricultural products, do not extend in a way that negates the overall objective of providing access opportunities to their own markets.

Since it was first produced in July 2007, negotiation text in agriculture goods has been revised three times. The latest revision of the text including what could become the formulas for cutting tariffs and trade-distorting agricultural subsidies in a final deal were issued on 10 July 2008. The text was previously revised in May and February 2008. The recent revision of the text is the outcome of the latest discussions in negotiation group and is a focus of crucial talks for a representative group of ministers who met in Geneva from 21 July 2008.[1] If there is enough give and take on all sides, a more liberal multilateral agricultural trading system thus should emerge from the successful conclusion of the Doha Round.

There is considerable debate as well as confusion on the implications of multilateral agricultural trade liberalization, particularly elimination of farm subsidies, on the poor countries. There is a nearly broad based consensus among a few pressure groups and many international institutions that elimination of farm subsidies by rich countries will benefit the poorest, least developed countries (LDCs). The main arguments are as follows. Agricultural subsidies and price supports allow rich countries to sell their agricultural products on world markets at prices that are below the cost of production. Critics thus claim that these policies inflict harm on poor countries by depressing world commodity prices artificially and thus making the food produced by them uncompetitive with imports. They also argue that these subsidies increase the volatility of commodity prices since support policies that are counter-cyclical with respect to domestic prices or shocks provide incentives for increased production when world prices are low. Further, they argue that these policies are likely to hurt the poorest residents of the poor countries because poor people are often farmers. Thus, eliminating support for rich country farmers will raise world prices and the incomes of the poor. Some even argued that LDCs can become net exporters once world prices increase as a result of elimination of agricultural support in rich countries.

However, some liberal trade economists are skeptical with above arguments. According to Jagdish Bhagwati, agricultural subsidies are certainly undesirable but the claim that removing them will help the poorest counties is “dangerous nonsense” and a “pernicious fallacy”. The main argument rests on a following observation: most poor countries are net importers of agricultural goods. As net food importers, they may be hurt by higher commodity prices that would result from agricultural liberalization in rich countries (Valdes and McCalla 1999; Panagariya 2002, 2004a, 2004b). Even the possible gain that net agricultural exporters in LDCs may enjoy from agricultural liberalization in rich countries are likely to be offset by other associated changes (Panagariya 2004 a; 2004 b). The premium enjoyed by LDCs exporters (except rice, sugar and bananas) under Everything But Arms (EBA) initiative, which allows them duty – and quota – free access to the EU markets, in terms of benefiting from the higher prices prevailing in the EU would be adversely affected. Opening up the EU markets to all comers will lower EU internal prices and hurt the LDCs sellers. Likewise, LDCs exporters will find difficult to comply with less transparent regulatory policies which rich countries may eventually replace more conventional barriers such as tariffs and quota.

Because of the diversity both within and among poor countries, the extent to which rich country support policies translate into lower incomes in LDCs is an empirical question. Some countries may import

[1] With the Doha trade round going through crucial stage, there is temptation to grab any hold of any opportunities for optimism. It has become commonplace to assert that the food crisis, while a tragedy, is a shot in the arm for Doha. However, Bhagwati and Panagariya (2008) do not buy all the arguments that are offered in support of such propositions.

cereals, such as rice, wheat and maize, but export other commercial agricultural products such as sugar. Higher prices for exports and imports will have net effects that are difficult to predict *ex ante*. Even within importing countries, the poorest members of society may be net sellers of food.

The proposed study aims to assess the impact that the multilateral agricultural trade liberalization, particularly removal of the farm subsidies in major food items (such as rice, maize and wheat), could have on household welfare in Nepal.

This study is organized as follows. While this section provided background of the study, section two surveys literature on trade, trade policy and poverty. Section three presents the empirical methodology used to estimate the extent of price transmission from world prices to local markets and the wage impact of changes in domestic prices, and to simulate the impact of increase in world prices resulting from global agricultural trade liberalization on household welfare. Section four describes structure of Nepalese agriculture. Section five presents results of the price transmission estimates, wage earning equation estimates and simulation exercise. Concluding section summarizes key findings and draw policy implications.

2. Survey of Literature

In his comprehensive paper, Winters (2000) identifies several key linkages between trade, trade policy, and poverty, which are reiterated in large part by Bannister and Thugge (2001). Potential links include changes in: (a) the price and availability of goods; (b) factor prices, income, and employment; (c) government taxes and transfers influenced by changes in revenue from trade taxes; (d) the incentives for investment and innovation, which affect long-run economic growth; (e) external shocks, in particular, changes in the terms of trade; (f) short-run risk and adjustment costs.

There has been a growing body of empirical literature that have assessed the impact of global agricultural trade liberalization by examining the linkages mentioned above. The studies have used various approaches to assess the effects of global trade liberalization including partial equilibrium, computable general equilibrium models (CGE) and macro-econometric models (Hertel and Reimer 2004). Tongeren et al (2001) have provided a comprehensive survey of the CGE based impact assessment studies on agricultural trade liberalization carried out in 1990s with particular focus on agricultural reforms in Europe. There have been another wave of impact assessment studies of agricultural liberalization with the Doha Round of negotiations (for example, see Beghin et al 2002; Diao et al 2001; Francois et al 2003; Franden et al 2003; Hertel at al 2003; Goldin et al 2003). Although these models have not produced similar results, many of these studies have concluded that developing countries are benefited from the Doha Round.

With the adoption of the July Package, another wave of studies have emerged in quantifying possible effects of trade liberalization on different regions in the world using the elements of the package as inputs and scenarios for quantitative assessments. Similar to previous assessments, these studies have been carried out by using large-scale global Computable General Equilibrium (CGE) models such as GTAP model.

The results of the World Bank research program on the implications of Doha Development Agenda (DDA) for developing countries have been the most influential assessments of trade liberalization under the Doha round (Anderson and Martin 2005 a, 2005 b, 2005c. 2005d, 2000e, 2000f, 2005g and Anderson et al 20005). In the analysis of agricultural trade liberalization of the World Bank research project, Anderson, Martin and their associates (2005) have focused on three “pillars” of Doha Round of trade negotiations, including market access, export subsidies and domestic support. Anderson et al (2005) and Anderson and Martin have summarized the results. The main features of their results are as follows: (i) around two-thirds of global economic gains come from agricultural trade liberalization; (ii) more than half of the gains to developing countries come from agricultural trade liberalization would come from agricultural trade liberalization by developing countries themselves; (iii) developing countries merchandize trade liberalization would contribute about 45 % to the global welfare gains; (iv) developing countries own agricultural trade reforms contribute to their own welfare gains more than the developed countries’ agricultural trade liberalization; (v) around 93 % of gains come from agricultural trade liberalization import

market access (or cut in import tariffs in agriculture); and (vi) abolition of export subsidies and reduction in domestic support in agriculture would contribute only small percentage to total gains from agricultural trade liberalization (2 % and 5 % respectively) - welfare of high income countries increases (5 %) from abolition of export subsidies while it declines (-3 %) in case of developing countries.

The results of the World Bank on the distributional impact of the welfare change across countries and regions from agricultural trade liberalization (tiered agricultural tariff cuts, elimination of export subsidies and cuts in actual domestic support as of 2001 of 28 % in US, 18 % in the EU and 16 % in Norway) is shown in Table 3. The most striking features of these results is that countries in Asia-Pacific are the main winners of Doha agricultural trade liberalization. However, the big winners in the region are developed countries such as Japan, Korea, Taiwan, Australia and New Zealand and Thailand, while China, Vietnam, Singapore and Hong record small losses. Although South Asia and Southeast Asia would gain from agricultural trade liberalization, the gains are very small.

Hertel and Keeney (2005) have also examined the effects of full agricultural trade reforms by high income countries under DDA. Their results indicate a substantial increase in global welfare (US$ 56 billions), out of which the gain to developing countries account for 21 percent (US$ 12 billions). Import market access for agricultural products has been the source of welfare gain. The relative contribution of abolition of export subsidies and domestic support has been minimal. Countries such as Bangladesh, Vietnam, and the Philippines in Asia and Pacific would loose while big countries India and China would gain.

Antimiani et al (2005) examined the effects of agricultural trade liberalization under alternative scenarios by incorporating the outcome of interactions between the strategies of country groups in the negotiations. The gains from agricultural liberalization in their study are similar to the World Bank study. The total global welfare gains is around US$ 69.2 billion (2013) and total Asia-Pacific gains is around US$ 31.6 billion (around 46 %). Once gain Japan, Korea, Taiwan and Thailand are the biggest winners in the region and countries such as China, Vietnam, Bangladesh and Indonesia would marginally loose from agricultural trade liberalization.

According to Bouet et al (2004 and 2005), the above studies are highly optimistic. The reasons are as follows: " *(i) protection is not precisely measured; traditionally, it does not include trade preferences, regional agreements, and the gap between applied and bound protection, at a disaggregated level; (ii) the complex effects of the various types of domestic support are not accounted for; (iii) various groups of DCs are not distinguished (net exporters vs. net food importers, LDCs benefiting from huge trade preferences, LDCs with main exports surely penalized by tariff peaks….)"*.

The results by Bouet et al (2004 and 2005) agricultural trade liberalization under DDA would lead to very small increase in global welfare (0.08%). The results across countries and regions indicate that developing countries in Asia and Pacific would gain from agricultural trade liberalization. However, agricultural trade liberalization would result to welfare losses in country groups such as Sub-Saharan Africa, Mediterranean, and poorest countries in the world. In general, unlike previous CGE studies, Bout et al (2004, 2005) suggests that the welfare gains from agricultural trade liberalization is very small.

Above studies have put other countries that lose into a broader region (for example, Nepal into rest of South Asia) such that gains to other countries in the region offset their loses. Moreover, above CGE based impact studies assume a representative agent and focuses on relative price effects and getting macroeconomic aggregates right. As opposed to above CGE based impact studies, there are studies that use household survey data to econometrically assess the effects of trade liberalization. They assume heterogeneity of individuals and households as revealed though surveys. Most of these studies also recognizes dual role of the most households in developing countries in terms of them being both producers and consumers.

One of the important example in this category is the study by Minot and Golleti (2000), who examined the in-depth impact of rice market liberalization on income and poverty of Vietnamese households. They estimate household demand behavior and link this to muti-market spatial equilibrium model of rice production and consumption. However, Minot and Golleti (2000) assume that labor demand and wage

arte remain constant to changes in rice prices. Since rice production is quite labor intensive in Vietnam, a change in rice price should change labor demand for agricultural labor, and consequently the agricultural wage rate.

In a study of rural labor markets in Bangladesh, where hired labor is very important for many of the rural poor, Ravallion (1990) addresses analyses both the short- and long-run impacts of an increase in the price of rice on rural wages and poverty. He derives a simple condition, which may be used to determine whether such households will gain from an increase in the price of rice. This requires that the elasticity of wages with respect to the price of rice exceeds the ratio of net food (rice) expenditures divided by net wage income. Based on his short and long run estimates of this wage elasticity, he concludes that the average landless poor household loses from an increase in the rice price in the short run (when the wage elasticity is relatively small), but gains in the long run (5 years or more) as the elasticity of wages, with respect to the price of rice, rises over time.

Porto (2003a, 2003b) offers a natural generalization of Ravallion's work for the case of Argentina. He estimates a set of wage equations for unskilled, semi-skilled and skilled labor, where the explanatory variables are tradable commodity prices, educational attainment and individual household characteristics. He then utilizes the resulting wage-price elasticities to estimate the impact on wages of potential changes in domestic commodity prices owing to trade reforms. In one paper, he provides an *ex post* analysis of the distributional impacts of MERCOSUR, concluding that it had a pro-poor bias (Porto, 2003b). By removing policies that favored the rich relatively more, MERCOSUR is estimated to have a favorable impact on the distribution of income in Argentina. In a separate paper, Porto (2003a) uses the same framework to conduct an *ex ante* assessment of prospective domestic and foreign trade policy reforms. In this case, he draws on outside estimates of the impact of foreign trade reforms on world prices. He concludes that foreign reforms are more important than domestic reforms when it comes to potential poverty alleviation.

Nicita (2003) uses the same approach as Porto to estimate how Mexican trade liberalization in the 1990's affected poverty. In addition, he accounts for differential price transmission from the border to different regions of the country. Nicita concludes from his *ex post* analysis that households gained from lower priced consumption goods, in the wake of trade reforms, but these gains were largely offset by reductions in unskilled wages and agricultural profits. With the poorest households hardest hit by these income losses, Nicita concludes that they gained much less than the rich. Therefore, the trade reforms are estimated to have increased income inequality.

Karmacharya (2006, 2007) has examined the impact of OECD agricultural trade liberalization in Nepal. They were examined in two steps. Firstly, he estimated the extent of price transmission from world prices to local markets for the selected agricultural products (paddy rice/milled rice, maize, wheat, sugarcane/sugar). Secondly, using these estimates, he simulated the short- and long-run impact of OECD agricultural liberalization on household welfare. Welfare analysis is done through total differentiation of the indirect utility function of a household. The farm household model was used for this purpose. He found out that following OECD liberalization: (i) Nepal eventually experiences small increase in domestic prices for paddy/milled rice, maize, wheat, and sugarcane/sugar; and (ii) for three of the four commodities, household welfare declines in both short and long run because Nepali households tend to be net food importers. In conclusion, OECD agricultural liberalization tends to be harmful to the extent that it matters.

However, the study by Kamacharya (2007) has following major limitations. Firstly, the study assumes transmission between world prices and Nepalese interior prices directly by ignoring state of Nepal's de-facto economic integration with India. Nepal is a landlocked country with a long porous border as well as a preferential trade agreement with India. India thus has a major influence on Nepal's economy (Blejer and Szapary 1991; Karmacharya 2002; 2003). Unless the commodities considered in the study have been excluded from the free trade list in the bilateral agreement between two countries, which are not so, one would expect the price of these commodities at the border of Nepal would be the same as that in India (). Whatever the price differences are seen could be largely due to quality differences. Moreover, Indian agricultural policies which provide the large subsides and farm support programs to its farmers

have also exposed Nepalese farmers to artificially low border prices. In short, Indian border prices should be used to measure the extent of price transmission from border prices to domestic markets in Nepal.[2] Secondly, the study assumes uniform price transmission of world prices across Nepal implying perfect spatial integration of domestic markets. However, Nepal has three hierarchical geographic regions, namely, the mountains, hills and plains (the terai), across which lack of spatial integration is colossal. Normally, one would think that marketing margins would be much higher for remote areas of the country such as the mountains and would be followed by the hills and the tarai. Any change in world or Indian prices will have asymmetric impacts across regions in Nepal. Finally, welfare analysis in the study, which is done through total differentiation of indirect utility function of a household, assumes zero wage effect to commodity price changes. However, change in commodity prices would affect demand for agricultural labor, and consequently the agricultural wage rate. Higher commodity prices would then lead to greater increase in household welfare, particularly in households that derive share of their income from agricultural labor. For these reasons, Karmacharya's simulation exercises do not fully reflect household welfare impact of agricultural trade liberalization.

3. Empirical Methodology

In order to evaluate the impact of global agricultural liberalization on household welfare, the present study addresses the methodological limitations of the study by Karmacharya (2007). Accordingly, the proposed study has made following methodological improvements: (i) use of Indian border prices to measure the transmission of change in Indian border prices to domestic markets in Nepal; (ii) lack of spatial integration and consequently asymmetric impact of border price changes across hierarchical geographical regions of Nepal; and (iii) wage impact to change in commodity prices.

The study has proceed in three steps. First, the study estimated the extent of price transmission from Indian prices (resulting from global agricultural trade liberalization) to markets in Nepal's three hierarchical geographic regions - namely, the terai, hills and the mountains - for the selected agricultural products (paddy rice/milled rice, maize, wheat). Second, the study assesses the impact of local commodity prices on wages in different geographic regions by estimating earning equation. Finally, using these estimates, the proposed study simulates the impact of changes in border or Indian prices (rice, maize, wheat) resulting from global agricultural trade liberalization on household welfare in Nepal. They are described below.

3.1 Price Transmission from India to Domestic Markets

The extent of price transmission from India to markets in terai, hills and the mountains depends on how well integrated these markets with the Indian market. Distance to ports, road infrastructure, transaction costs, agricultural trade and domestic policies, access to information all play role. These characteristics are likely to vary for terai, hills and the mountains affecting the impact that change in Indian prices will have on domestic prices in each geographical region.

First, we use an Engle-Granger residual-based tests to determine the long-term cointegrating relationship between each of the local prices in geographical region "r" and the Indian prices for goods g

$$\ln p_{gt}^{dr} = \alpha_{gr} + \gamma_g^r \ln p_{gt}^{Ind} + \mu_t \qquad (3.1.1)$$

If in fact a cointegrating relationship between the price pairs exists, the OLS estimator is consistent despite the problem of the apparent problem of non-stationarity of the price-time series. The prices used in the analysis are in log form, which allows us to interpret the coefficient of integration (γ_g^r) as long-term

[2] Professor T. N. Srinivasan suggested this while commenting on the study by Karmacharya's during his presentation in GDN's Annual Conference in Beijing, 2007.

elasticities of the local prices with respect to Indian prices. To establish cointegration, the residuals μ_t are tested for unit root using the Augmented Dickey-Fuller (ADF) procedure.[3]

In addition to estimating the cointegrating vectors we estimate an error correction model to explain the dynamics around the long-term cointegrating relationship. The response of local prices in geographical region "r" to changes in the Indian price is decomposed into an immediate change following the shift in prices and an adjustment to the long-term equilibrium in the following period:[4]

$$\ln p_{gt}^{dr} - \ln p_{grt-1}^{dr} = \phi_g^r + \delta_g^r (\ln p_{gt}^{Ind} - \ln p_{gt-1}^{Ind}) + \varphi_g^r (\ln p_{gt-1}^{dr} - \alpha_g^r + \gamma_g^r \ln p_{gt-1}^{Ind}) + \nu_t \quad (3.1.2)$$

where p_{gt}^{dr} is the domestic price of goods "g" in geographical region "r' in period t and p_{gt}^{Ind} is the corresponding Indian prices; δ_g^r captures the instantaneous response of domestic prices to changes in Indian prices, and φ_g^r is the error-correction parameter, which captures the speed of adjustment of p_{grt}^{d} to its long-run equilibrium $\gamma_g^r p_{gt}^{Ind}$. We will use the residuals from the Engle-Granger cointegration test (μ_t) for each state as the error-correction term. Again, OLS will be used to estimate equation (3.1.2). Prior to estimation we ensure that the first differences of the price time series used in the error-correction model (3.1.1) are stationary using an ADF test.

The percentage change in domestic prices of goods g in region r (for short and long-run) due to change in Indian prices, which would result from global agricultural trade liberalization, is given by

$$dp_g^r = \delta_g^r \, dp_g^{Ind} \text{ (short run)} \quad (3.1.3a)$$

$$dp_g^r = \gamma_g^r \, dp_g^{Ind} \text{ (long run)} \quad (3.1.3b)$$

where is the percentage change in domestic prices of goods g in India resulting from global agricultural trade liberalization.

3.2 Impact of Changes in Local Commodity Prices on wages

It is well known that if changes in border price passes through on domestic prices, the factor market will be in disequilibrium, thereby resulting in factor income adjustments. Moving beyond the predictions of the Stolper –Samuelson theorem to actual changes, as Topel (1986) first suggested, worker heterogeneity is important for labor earnings. Therefore, besides the movement of prices, data on wages that can be differentiated by geographic regions, demographic groups, and individual characteristics would be crucial for a successful examination of change economic shocks are transmitted across different households.

This suggests using a model that, in estimating earnings, takes into both the movement of good prices and worker characteristics. Following the approach of Porto (2003) and Nicita (2004), the earning equation for each individual can be written as:

$$W_{ih} = W_{ih} (P_g, Z_i) \quad (3.2.1)$$

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[3] The ADF test for a unit root (with drift but without trend) involves estimating the following equation for a time series variable y_t: $\Delta y_t = \beta + \lambda y_{t-1} + \sum_{j=1}^{k} \eta_j \Delta y_{t-j} + v_t$ where k is the number of lags of the first differences used. The null hypothesis is that each of the time series follows a nonstationary process with a unit root, i.e., $\lambda = 0$ (which is tested against using $\lambda \prec 0$). If the null of unit root is rejected, we proceed as if the domestic and Indian price series are cointegrated.

[4] See Baffes and Gardner (2003) and Krivonos and Olarreaga (2006) for a detailed derivation

where W_{ih} is the wage rate of individual i in household h, P_g is a vector for goods g, and Z_i is a vector of individual characteristics.

Wage response to price changes will be estimated by following a varying coefficient model (Hsiao 1986) where the variability of the coefficient is given by regional differences. The estimating earning equation, which incorporates the role of product prices and worker characteristics, can be expressed as:

$$\ln w_{ih} = \sum_{g,r,s} \theta^r \theta^s \ln p_{gih}{}^r \beta_{gih}{}^{r,s} + Z_i \sigma + e_{ih} \qquad (3.2.2)$$

where w_{ih} is the observed wage of individual i in household h, $p_{gih}{}^r$ is the price of good g faced by individual i in household h in region r, and Z_i is a vector of individual characteristics (age, gender, household head status, and type of employment). Finally, θ^r and θ^s represent dummy variables for region of residence and worker's education level, and is an error term. In short, the study will regress individual wages on the prices of goods interacted with regional and educational dummies, plus individual controls.

Equation (3.2.2) is estimated by a standard OLS procedure. The percentage change in wages (dw_h) of household h resulting from change in domestic prices of goods g can be obtained by calculating:

$$dw_h = \sum_{gs} \beta_g \, dp_{gh} \qquad (3.2.3)$$

where β_g is the price-wage elasticity for good g from equation (3.2.2), and dp_g is the percentage change in price faced by the household from equation (3.1.3). For the sake of simplicity, the subscripts for region, are omitted.

3.3 Impact of Change in Indian Prices on Household Welfare

The effect of change in Indian prices, resulting from global agricultural trade liberalization, on household's welfare in Nepal is estimated by employing farm household model (Singh, Squire and Strauss 1986), which recognizes dual role of the most households in developing countries in terms of being both consumers and consumers at the same time. They are analyzed at two level: short-term, and long-term. For the short-term analysis, we only track the changes in prices and calculate the effects on household welfare by feeding the new prices into the model. For the long term analysis, we track change in prices, and change in production by assuming substitution in both production and consumption. Household welfare analysis will be carried out at different geographical regions. However, for the sake of simplicity, the farm household model described below omit subscript for geographical region.

3.3.1 Long-term Analysis

For the long-run analysis, we implement the simple partial equilibrium model developed by Nicita (2004) and Minot and Golleti (2002) which takes into account the second-order effects for consumption (both the adjustment in the expenditure basket as well as the changes in income of the household) and that for production (substitution effects). Following Nicita (2004), the indirect utility function of household h in any particular geographic region can be written as:[5]

$$u_h = V_h (y_h, P) = V_h (m_h + \pi_h, P) \qquad (3.3.1)$$

Household utility u_h is expressed as a function of a vector of prices of goods P faced by the household and the household's income y_h. Total income is the sum of the income from farm activity π_h, and non-farm activity m_h, which in turn includes earned income (wages) and unearned incomes (gift, transfers and remittances)

[5] Social welfare is just the sum of all household's welfare.

Second-order effects for consumption are calculated from the indirect utility function by differentiating equation (3.3.1) following second-order Taylor series expansion approximation. This leads

$$du_h = \sum_g (\delta u_h / \delta p_g)\, dp_g + (\delta u_h / \delta y_h)\, dy_h + \tfrac{1}{2} \Big[(\delta u_h^2 / \delta y_h^2)\, d y_h^2 + \sum_g 2 (\delta u_h^2 / \delta y_h \delta p_g)\, dy_h\, dp_g \Big] + \tfrac{1}{2} \Big[(\delta u_h^2 / \delta p_g)\, dp_g^2 + \sum_g \sum_{k \neq g} 2 (\delta u_h^2 / \delta p_g\, \delta p_{k \neq g})\, dp_g\, dp_{k \neq g} \Big] \quad (3.3.2)$$

The expression can be simplified by assuming the marginal utility of income $\delta u_h / \delta y_h = 1$, and by applying Roy's identity ($\delta u_h / \delta p_g / \delta u_h / \delta y_h = -c_g$). Hence, equation (3.3.2) can be written as:

$$du_h = dy_h - \sum_g c_g - \sum_g \Big[(\delta u_h / \delta y_h)\, c_g\, dp_g \Big] - \tfrac{1}{2} \Big[\sum_g (\delta c_g / \delta p_g)\, dp_g + \sum_g \sum_k 2 (\delta c_g / \delta p_g\, \delta p_{k \neq g})\, dp_g\, dp_{k \neq g} \Big] \quad (3.3.3)$$

where du_h is the approximation of the monetary value of the changes in indirect utility for household h, c_g is the consumption of good g and dp_g is the changes in prices of good g.

Income of the household h is given by the sum of labor income and profits associated with the household's own production of a particular good.

$$y_h = w\, l_h + \sum_g \pi_{hg} \quad (3.3.4)$$

where w is the prevailing wage rate, l_h is the (net) amount of labor sold in the market by household h and π_{hg} are the profits obtained from direct selling goods in the market.

Further, assume that households choose optimally the amount of labor to sale in the labor market and the amount to produce in their own business. Then, the effect of prices and wages on profits can be obtained by differentiating (3.2.4) using Hotelling's Lemma ($d\pi_h / dp_g = x_{hg}$), which yields:

$$dy_h = dw\, l_h + \sum_g \pi_{hg}\, dp_g \quad (3.3.5)$$

where x_{hg} is the quantity of good g sold on the market by the household h. Substitute equation (3.3.5) into (3.3.3), divide everywhere by income of household h assuming that income equals expenditure, and rearranging terms to obtain the percentage in welfare:

$$(du_h / y_h) = \theta^{l}_{hg}\, dw_h + \sum_g \theta^{x}_{hg}\, dp_{gh} - \sum_g \theta^{c}_{hg}\, dp_{gh} - \sum_g \eta_{hg} \theta^{c}_{hg}\, dp_{gh} - \tfrac{1}{2} \Big[\sum_g \varepsilon_{hg} \theta^{c}_{hg} (dp_{gh})^2 + \sum_g \sum_{k \neq g} 2 \varepsilon_{hg} \theta^{c}_{hgk}\, dp_{gh}\, dp_{kh} \Big] \quad (3.3.6)$$

where η_{hg} is the income demand elasticity, ε_{hg} is the price elasticity of demand and ε_{hgk} is the cross price elasticity of good g to k. And where $\theta^{c}_{hg} = p_{gh}\, c_{gh} / y_h$ is the share of income spent on good g by household h; $\theta^{l}_{hg} = w\, l_h / y_h$ is the share of income obtained in the labor market by household h and $\theta^{x}_{hg} = p_{gh}\, x_{gh} / y_h$ is the share of income household h obtained by selling good g in the market at price p. Finally, changes in wages (dw_h), prices (dp_{gh}) and income (dy_h) are expressed in percentage terms.

Consider also the second-order effects for production. Following Minot and Golleti (2002), equation

(3.3.6) can be extended as:

$$(du_h / y_h) = \theta^{I}_{hg}\, dw_h + \sum_g \theta^{x}_{hg}\, dp_{gh} + \tfrac{1}{2}\Big[\sum_g \omega_{hg}\theta^{x}_{hg}(dp_{gh})^2$$

(labor) (production) (supply price effect)

$$+ \sum_g \sum_{k\neq g} 2\,\omega_{hgk}\,\theta^{x}_{hg} dp_{gh} dp_{kh}\Big] - \sum_g \theta^{c}_{hg}\, dp_{gh} - \sum_g \eta_{hg}\theta^{c}_{hg} dp_{gh}$$

(supply cross price effect) (consumption effect) (income demand effect)

$$- \tfrac{1}{2}\Big[\sum_g \varepsilon_{hg}\theta^{c}_{hg}(dp_{gh})^2 + \sum_g \sum_{k\neq g} 2\,\varepsilon_{hgk}\theta^{c}_{hg}\, dp_{gh}\, dp_{kh}\Big] \qquad (3.3.7)$$

(demand price effect) (demand cross price effect)

where ω_{hg} is the price elasticity of supply and ω_{hgk} is the cross price elasticity of supply of good g to k.

Equation (3.3.7) suggests that a change in the price of good g favors or harms the household to an extent given by the "net exposure" of its budget to that particular good. Equation (3.2.7) is a measure of the percentage change in money metric utility, whereby the indifference curves of individual preferences ordering are labeled by the amount of money needed to reach them at some fixed level of prices, which is commonly approximated by real income (Deaton and Muellbauer 1980).

Taking into account the different types of labor by their education level and the fact that estimates price-wage elasticities are by region, equation (3.3.7) is rewritten as:

$$(du_h / y_h) = \sum_{gs} \theta^{s}_{hg}\, dw_h^{r,s} + \sum_g \theta^{x}_{hg}\, dp_{gh} + \tfrac{1}{2}\Big[\sum_g \omega_{hg}\theta^{x}_{hg}(dp_{gh})^2$$

(labor) (production) (supply price effect)

$$+ \sum_g \sum_{k\neq g} 2\,\omega_{hgk}\,\theta^{x}_{hg} dp_{gh} dp_{kh}\Big] - \sum_g \theta^{c}_{hg}\, dp_{gh} - \sum_g \eta_{hg}\theta^{c}_{hg} dp_{gh}$$

(supply cross price effect) (consumption effect) (income demand effect)

$$- \tfrac{1}{2}\Big[\sum_g \varepsilon_{hg}\theta^{c}_{hg}(dp_{gh})^2 + \sum_g \sum_{k\neq g} 2\,\varepsilon_{hgk}\theta^{c}_{hg}\, dp_{gh}\, dp_{kh}\Big] \qquad (3.3.8)$$

(demand price effect) (demand cross price effect)

where θ^{s}_{hg} denotes the share of income from labor with different education level. The parameters $dw_h^{r,s}$ are obtained from the estimation equation (3.2.2).

3.2.2 Short-term Analysis

For the short- run analysis, we assume the first-order effects on household welfare through the changes only in the price of commodities, assuming that the households cannot change their activities in response to a price change in the short-run (quantities consumed and produced are assumed unchanged). Accordingly, equation (3.3.7) is reduced to:

$$(du_h / y_h) = \sum_g \theta^x_{hg}\, dp_{gh} - \sum_g \theta^c_{hg}\, dp_{gh} \qquad (3.3.9)$$

(production) (consumption)

Given the values of share on (θ^l_{hg}, θ^x_{hg}, θ^c_{hg}) and income (η_{hg}), price (ω_{hg}, ε_{hg}) and cross-price (ω_{hgk}, ε_{hgk}) elasticities, the data sources for which is discussed below, equation (3.3.7) and (3.3.8) can be estimated by substituting the values of dp_{gh} from (3.1.3) and from dw_h (3.2.3).

4. Structure and Performance of the Nepal's Agricultural Sector

The agriculture sector is central to the livelihood of Nepalese, contributing to around 40 % of the country's GDP and employing 76 % of its labor force. Food grains (including cereal crops such as paddy rice, maize, wheat, millet and barley; and pulses) alone account for 34 percent in agricultural GDP. Paddy is the most important cereal crop, both in terms of cultivated area and in terms of production, followed by maize and wheat. For example, paddy accounts for about 46 percent of total cereal cultivated area followed by 24 percent for maize and 20 percent for wheat. The importance of agriculture as the single most important provider of livelihood for 90 % of Nepal's population implies that the trade of these agriculture crops will have a decisive effect on poverty reduction.

According to the 2001-02 Agricultural Census, cereal crops cover more than 80 percent of total cultivated land in Nepal followed by cash crops which account for about 10 percent of the agricultural land, and pulses (about 8 percent). Paddy is the most important cereal crop, both in terms of cultivated area and in terms of production, followed by maize and wheat. For example, paddy accounts for about 46 percent of total cereal cultivated area 24 percent for maize and 20 percent for wheat. Similarly, the 2003-04 Nepal Living Standard Survey (NLSS) data reveal that paddy, wheat and maize crops accounted for 66 percent of total gross crop output, down from 72 percent in 1995-96.

Availability of reliable trade data on agricultural crops is a huge problem. However, it can be safely said that Nepal is the net importer of food (Table 1). Import of food is carried through both formal and informal channels (Karmacharya et al 2004; 2005). The importance of agriculture as the single most important provider of livelihood for 90 % of Nepal's population implies that the trade of these agriculture crops will have a decisive effect on poverty reduction.

Table 1: Trade of Major Food Items (in MT. 1000)

Commodities	1979-81	1989-91	1999	2000	2001	2002	2003	2004	2005
Rice and Products									
Import (M)	7.9	7.5	40.8	206.5	47.0	19.9	46.0	39.1	116.5
Export (X)	27.9	0.1	25.3	0.0	4.6	0.9	N/A	18.3	5.8
Net Trade (X-M)	20.0	-7.4	-15.5	-206.5	-42.4	-19.0	N/A	-20.7	-110.7
Maize and Products									
Import (M)	0.0	0.6	13.9	3.5	0.1	1.8	N/A	39.4	43.1
Export (X)	8.0	1.0	0.4	0.0	0.2	0.0	N/A	0.0	0.0
Net Trade (X-M)	8.0	0.4	-13.5	-3.5	0.1	-1.8	N/A	-39.4	-43.1
Wheat and Products									
Import (M)	33.3	2.8	26.0	4.5	3.4	11.5	20.0	39.6	2.2
Export (X)	0.0	0.7	27.1	3.2	7.5	9.1	N/A	4.8	3.1
Net Trade (X-M)	-33.3	-2.1	1.1	-1.3	4.1	-2.4	N/A	-34.8	0.9

(Source: FAO and Ministry of Agriculture, Nepal) a : The figure represent for 1990. b : The figure represents for 1995. N/A means not available.

The commodities (paddy rice/milled rice, maize, wheat and sugarcane/sugar) considered in this study are major items in Nepalese household income and consumption. The production of three food crops - mainly rice, maize, and wheat – together accounts for about 22.2 percent of household income in Nepal (Table 2). Rice accounts for the largest share (15 percent) of the household income followed by maize (4 percent), and wheat (3 percent). For different categories of households, production share of these three commodities in their total income are as follows: households in mountains share the largest (31.3

percent) followed by terai (22.5 percent) and hills (20.2); rural households shares 25.4 percent while it is 6.7 percent for the urban households; and poor households share 24.4 percent while it is 21.1 percent for the non-poor households.

Households in Nepal spend 36.6 percent of their total income by consuming milled rice, maize, and wheat (Table4). Households in Nepal spend largest portion of their income on rice (27.5 percent) followed by maize (5 percent), and wheat (4 percent). For different categories of households, expenditure share of these three commodities in their total income are as follows: household from mountains spend largest (42.8 percent) followed by those from hills (31 percent) and terai (22 percent); rural households spends largest (40 percent) followed by those from urban areas (18 percent); poor spends more (46 percent) than non-poor(32 percent). Comparison of Tables 2 and 3 reveal that the households in Nepal are on average the net buyers of rice, wheat, and maize. However, the households are deficit in rice by a larger magnitude.

Table 2: Production Share of Selected Agriculture Goods by Household Group

Household Classifications	Production Share of Selected Goods in Total Household Income (in %)		
	Rice	Wheat	Maize
Ecological Belts			
Mountains	15.52	3.78	12.00
Hills	10.71	2.38	7.22
Terai	17.45	3.68	1.40
Location			
Urban	5.26	0.51	0.92
Rural	16.48	3.71	5.17
Income Category			
Poor	14.22	3.61	6.52
Non Poor	14.75	2.94	3.40
Nepal	14.57	3.17	4.44

Source: Computed from Nepal Living Standard Survey (NLSS 2003/04) data.

Table 3: Expenditure Share of Selected Agriculture Goods by Household Group

Household Classifications	Expenditure Share of Selected Goods in Total Household Income (in %)		
	Rice	Wheat	Maize
Ecological Region			
Mountains	24.50	3.91	14.34
Hills	20.04	2.36	8.54
Terai	17.45	3.68	1.40
Location			
Urban	15.60	1.90	0.89
Rural	29.94	4.69	5.74
Income Category			
Poor	31.77	5.23	8.54
Non Poor	25.35	3.70	3.09
Nepal	27.49	4.21	4.91

Source: Computed from Nepal Living Standard Survey (NLSS 2003/04) data.

5. Empirical Results

We start by presenting the results of price transmission estimates. We then turn to the estimates of the wage elasticities with respect to prices of rice, wheat and maize. We conclude this section with the simulation results.

5.1 Price Transmission Results

We first check which of the Nepalese geographic regions are cointegrated with the Indian market and estimate the parameters of the long-term relationship between the local and Indian prices of rice, maize and wheat. The stationarity of the price times series used in the model is tested and the appropriate ADF statistics are reported in Table 4. The test in terms of level do not reject the unit root hypothesis for some price time series, particularly, Indian wheat and maize, mountains wheat and maize, hills maize, and terai rice and maize, However, the test in terms of first differences rejects the unit root hypothesis at either 5 or 10 percent level for all price time series. Thus, price differential can be used in the error-correction model.

Table 4: Prices: Stationarity and Engle-Granger test of cointegration for rice, wheat and maize

	Stationarity		Cointegration	
	Levels	Differences		
	ADF	ADF	ADF	R^2
Indian price				
Rice				
Coarse	-2.21*	-4.73***		
Medium	-2.11*	-5.06**		
Wheat	-1.70	-4.89***		
Maize	-2.26	-5.68***		
Nepal price				
Mountains				
Rice				
Coarse	-3.92**	-6.44***	-6.38***	0.58
Medium	-4.12**	-7.00**	-7.10***	0.67
Wheat	-3.35	-9.42***	-9.18***	0.75
Maize	-1.9	-4.37***	-4.12**	0.48
Hills				
Rice				
Coarse	-1.92	-5.00***	-7.08***	0.66
Medium	-1.51*	-5.37***	-4.61**	0.63
Wheat	-3.02**	-11.04***	-10.38**	0.78
Maize	2.43	-1.49***	-5.93**	0.65
Terai				
Rice				
Coarse	-1.09	-3.18**	-5.54***	0.64
Medium	-1.80	-5.13***	-4.32**	0.62
Wheat	-2.22**	-8.16***	-8.38***	0.65
Maize	-4.55	-6.65***	-5.61***	0.63

Notes:
* Null hypothesis of unit root and/or no cointegration rejected at 1 % significance;
** Null hypothesis of unit root and/or no cointegration rejected at 5 % significance,
*** Null hypothesis of unit root and/or no cointegration rejected at 10 % significance

We then test for a long-term cointegration between the local and the Indian prices as described by equation 3.1.1. The ADF test statistics, also reported in Table 4, imply that for all the geographical regions and all food crops considered in the study, we should reject the hypothesis of no cointegration between the local and the Indian either at the 5 or 10 percent significance level. For rice (Basmati) and maize, we reject the hypothesis at 10 percent.

The results of error-correction estimation for rice, maize and wheat are reported in Table 14. The long-term cointegration coefficient (γ) was obtained from equation (3.1.1) and the coefficients of short-term transmission (δ) and adjustment (φ) were estimated using equation (3.1.2). The results show that indeed Indian prices are differently transmitted to the geographical regions of the country, depending on their distance from the border and food crops in question. The transmission of Indian price changes to Nepal diminishes with distance from the border for all the food crops in question.[6] Accordingly, the extent of price transmission is highest in the terai followed by the hills and the mountains. Low level of transmission, particularly in mountains, may be due to poor transport and communication infrastructure. For rice (coarse), perfect transmission was found both in terai and hills with the long-term elasticity of 1.36 and 1.06 respectively followed by 0.29 in the mountains. The results imply that a 1 percent increase in Indian price of rice leads to 1 percent increase in the local price of rice in terai and hills in long run while it is only 0.29 percent in mountains. For maize, perfect transmission was found only in terai with the long-term elasticity of 1.1, while the corresponding figures for hills and mountains are 0.83 and 0.50 respectively. For wheat, price transmission elasticity varies from 0.81 in terai to 0.56 in hills to 0.03 in mountains.

The estimated coefficients can be used to calculate the adjustment in local prices n periods/months after a one-time change in the world price. With a 1 percent change in the world market price occurring at time t = 0, the initial percentage change in the local price is given by δ. In the following period the error-correction component φ is added; n periods after the change in the world price has occurred the domestic prices change by a percentage m_n:

$$m_n = \gamma - (\gamma - \delta)(1+\varphi)^n$$

Table 6 shows the adjustment after 6 months, 1 year and 2 year. The speed of adjustment of local prices is found to be directly proportional to distance from the border for all the food crops in question. Accordingly, the speed of adjustment in local prices, of all food crops in question, is faster in terai followed by hills and mountains. For rice (coarse), a 1 percent increment in the Indian price would increase the local prices in terai and hills by 0.8-1.0 percent within a period of 6 months to 1 year. In case of mountains, a 1 percent increment in the Indian price would increase the local prices of rice (coarse) only by 0.30 percent even after 2 years. For wheat, 80 percent of adjustment of local prices in terai occurs within the first year while the corresponding figure is 56 percent in the hills. The speed of adjustment of local prices for wheat in mountains is the lowest at only 3 percent even after two years. For maize, adjustment of local prices in terai occurs by 100 percent within 2 years. In hills, adjustment of local prices of maize occurs by 53 percent within 2 years which to 80 percent only after 10 years. The adjustment of local prices in mountains do not exceed than 50 percent even after 10 years.

[6] Nicita (2004) shows the similar results in case of Mexico.

Table 6: From Indian to local prices: error-correction model for rice, wheat and maize

	Long term elasticity (γ)	Adjusted R^2	Immediate adjustment or short term elasticity (δ)	Adjsutment to LR eq. or error correction parameter (φ)	Adjusted R^2	Speed of Adjustment		
						6 Months	1 Year	2 Year
Mountain								
Rice								
Coarse	0.29*	0.01	0.02	-0.56***	0.24	0.29	0.29	0.29
Medium	0.61**	0.15	0.02	-0.62***	0.30	0.61	0.61	0.61
Wheat	0.03*	0.01	0.07*	-0.54**	0.23	0.03	0.03	0.03
Maize	0.50***	0.83	0.26*	-0.44**	0.27	0.35	0.39	0.44
Hills								
Rice								
Coarse	1.06**	0.57	0.29	-0.16***	0.18	0.79	0.96	1.06
Medium	0.62*	0.15	0.19*	-0.06***	0.18	0.32	0.42	0.52
Wheat	0.56***	0.64	0.39**	-0.59***	0.28	0.56	0.56	0.56
Maize	0.83***	0.91	0.14*	-0.34***	0.06	0.27	0.37	0.53
Terai								
Rice								
Coarse	1.31**	0.482	0.28*	-0.11***	0.23	0.80	1.06	1.25
Medium	0.82**	0.17	0.43	-0.04**	0.35	0.51	0.58	0.67
Wheat	0.81***	0.88	0.52	-0.53**	0.24	0.81	0.81	0.81
Maize	1.1***	0.85	0.29**	-0.69***	0.33	0.65	0.85	1.02

Note: Significance level of 1 %, % %, and 10 %fare indicated by *, **, and *** respectively.

5.2 Price-Wage Elasticities

This section illustrates the extent to which movement in the domestic prices of food crops in question have influenced the return of labor as estimated from the model given by equation (3.2.2). The Stopler-Samuelson theorem gives full results only in a 2x2 model. A nxm case iinfinitely more complex and only can infer correlations between product prices and factor returns. Table 7 reports the estimated price-wage elasticities. No fixed pattern on price-wage elasticities emerges from these results. For rice, price-wage elasticties are positive in most cases. The positive values of price-wage elasticities vary from 10 percent for primary educated farmers in the mountains to 58 percent for literate only farmers in hills. The negative values of price-wage elasticities vary from 3 percent for primary level educated farmers in terai to 37 percent for literate only farmers in mountains. For wheat, price-wage elasticities are negative in most cases. The positive values of price-wage elasticities range from 3 percent for illiterate farmers in terai to 60 percent for illiterate only farmers in mountains. The negative values of price-wage elasticities range from 2 percent illiterate farmers in mountains to 62 percent for secondary level educated farmers in mountains. For maize, price-wage elasticties are positive in almost all cases. The positive values of price-wage elasticities vary from 3 percent for literate only farmers in terai to 72 percent for secondary level educated farmers in mountains. The negative values of price-wage elasticities vary from 2 percent for primary educated farmers in terai to 7 percent for literate only farmers in mountains.

5.3 Simulation results on impact of global agricultural trade liberalization on household welfare

Before carrying out simulation results, we first estimate change in Nepal's domestic prices for different geographical regions (in long term) due to change in Indian domestic prices that would result from change in world prices from global agricultural trade liberalization. For this purpose, we followed following steps. Firstly, we used estimates of changes in world prices for the food crops in question from different studies (Diao 2002; CARD 2002).[7] Secondly, we used estimates of price-transmission elastcities for India from different studies (FAO). We used both these information to calculate change in India's domestic prices. Thirdly, from the sub-section 5.1, we used estimates of long- term elasticities (γ) to calculate changes in Nepal's domestic prices across different geographical regions.

Table 7: Price wage elasticities

Dependent Variable: Log of Daily Wage

Control Variable		**Price wage elasticities**					
Variable Name		**Commodity/ Region**	**Illiterate**	**Literate**	**Primary**	**Secondary**	**Above**
Age	0.01 (0.68)**	**Rice**					
		Mountain	0.12 (0.60)**	-0.37 (-0.67)*	0.11 (0.42)*	0.2 (0.90)**	0.31 (0.59)**
Gender	-0.42 (-14.12)***	Hill	-0.30 (-2.76)***	0.52 (2.92)***	0.15 (1.08)**	0.05 (0.36)**	0.21 (1.56)**
		Terai	0.11 (1.35)**	0.39 (1.60)**	-0.03 (-0.23)*	0.49 (3.14)***	0.11 (0.57)**
Employment Type (Daily/ Long Term Paid)	0.13 (4.41)***	**Wheat**					
		Mountain	-0.02 (-0.13)	0.6 (1.15)**	-0.456 (-1.49)**	-0.62 (-1.63)**	-0.32 (-0.28)*
Employment Sector (Agro/ Non Agro)	0.56 (18.22)***	Hill	0.27 2.28)***	-0.36 (-1.97)***	0.06 (0.36)**	0.20 (1.25)***	-0.08 (-0.46)**
		Terai	0.04 (0.37)**	-0.13 (-0.53)**	0.32 (2.02) ***	-0.34 (-2.00)**	0.03 (0.12)*
Household Head Status (HH Head/ Other)	0.16 (5.72)***	**Maize**					
		Mountain	0.15 (0.60)**	-0.07 (-0.11)	0.63 (1.60)***	0.72 (1.38)***	0.19 (0.36)*
Constant	3.56 (18.35)***	Hill	0.33 (3.11)***	0.06 (0.40)**	0.04 (0.33)**	0.08 (0.69)**	0.33 (2.88)***
		Terai	0.10 (2.23)***	0.04 (0.19)*	-0.02 (-0.17)*	0.09 (0.79)**	0.27 (2.70)***

R Square = 0.44

Number of Observation = 3645

Note: All variables are in log, with the exception of dummies. Significance level of 1 %, % %, and 10 %fare indicated by *, **, and *** respectively.

Table 8 shows the resulting estimates of change in Nepal's domestic prices for food crops in question across different geographical regions. Nepal's domestic price change diminishes with distance from the border for all the food crops in question. For rice, Nepal's domestic price change varies from 3 percent in mountains to 8 percent in terai. For wheat, Nepal's domestic

[7] Appendix A provides the summary table of studies that estimated changes in world prices.

price change varies from 0.6 percent in mountains to 15 percent in terai. For maize, Nepal's domestic price change ranges from 2 percent in mountains to 6 percent in terai.

Simulation exercise is then carried out on the impact of global agricultural trade liberalization (full reform scenario) on household welfare in both short- and long-run. Short-run simulation results are obtained by using equation (3.3.9). Long-run simulation results are obtained by using equation (3.3.8) under the assumptions that **supply cross-price effects are zero**.[8] The labor effect component in equation (3.3.8) is measured by using price-wage elasticities discussed in section 5.2. The other components are measured by using supply and demand elasticities of the food crops in question which were estimated by Thapa and Rosegrant (1995) and are shown in Appendix B.

Table 8: Impact of global agricultural trade liberalization (full reform scenario [a]) on world and India's and Nepal's domestic prices

	Unit	Rice	Wheat	Maize
Change in world prices [b] (1)	%	10.00	18.20	7.00
India's price transmission elasticity [c] (2)		0.67	1.00	0.81
Change in India's domestic prices (3)= (1)x(2)	%	6.7	18.20	5.67
Nepal's price transmission elasticity (4)				
Mountains		0.45	0.03	0.50
Hills		0.84	0.56	0.83
Terai		1.18	0.81	1.10
Change in Nepal's domestic prices (5)=(3)x(4)	%			
Mountains		3.02	0.55	2.84
Hills		5.63	10.19	4.71
Terai		7.91	14.74	6.24

Notes:

a. Full reform scenario assumes removal of domestic support, import tariff and export subsidy.
b. Estimated changes in world prices resulting from global agricultural trade liberalization for food crops in question are obtained from following sources: (i) rice and wheat (Diao 2002) (ii) maize (CARD 2002).
c. They are obtained from Confroti (2004).

Table 9 shows the household welfare effects of the global rice trade liberalization. Both in short- and long-term, global rice trade liberalization adversely affects welfare for all categories of the households. For Nepal as a whole, household welfare declines by 16 percent and 23 percent in short- and long-term respectively. The decline in household welfare is largest in terai followed by hills and mountains. Above result implies that, negative demand-side effects are larger than positive labor and supply-side effects for all categories of households. There are several reasons for this. One of the main reasons is that the households are large net buyers of rice. Other reason is that household's demand response to rice price changes is bigger than its supply and wage response combined together. In sum, household is thus hurt by higher prices

[8] These assumptions were used due to unavailability of relevant parameters from secondary sources.

Table 9: Impact of global rice trade liberalization (full reform) on household welfare in Nepal

Household Classification	Labor Effect	Supply Side Effect (%)		Demand Side Effects (%)					Welfare Effect	
							Cross Price Effect			
		Production	Own Price	Consumption	Income	Own Price	Wheat	Maize	Short Term	Long Term
Region										
Mountain	0.40	0.88	0.01	1.39	0.95	-0.02	0.00	0.01	-0.51	-1.04
Hills	0.18	5.30	0.07	9.97	5.41	-0.24	0.00	0.00	-4.67	-9.59
Terai	6.04	10.74	0.24	21.21	7.12	-0.49	0.15	0.11	-10.47	-11.08
Income										
Poor	0.97	5.03	0.09	10.96	6.03	-0.30	1.34	0.65	-5.93	-12.59
Non Poor	5.65	11.89	0.23	21.61	7.44	-0.45	0.00	0.00	-9.72	-10.83
Nepal	6.61	16.92	0.32	32.57	13.48	-0.75	1.34	0.65	-15.65	-23.44

Table 10: Impact of global wheat trade liberalization (full reform) on household welfare in Nepal

Household Classification	Labor Effect	Supply Side Effect (%)		Demand Side Effects (%)					Welfare Effect	
							Cross Price Effect			
		Production	Own Price	Consumption	Income	Own Price	Wheat	Maize	Short Term	Long Term
Region										
Mountain	-0.10	0.04	0.00	0.05	0.02	0.00	0.00	0.00	-0.01	-0.13
Hills	5.15	1.94	0.07	1.95	0.64	-0.10	0.00	0.01	-0.01	4.66
Terai	2.10	4.12	0.09	6.94	-0.78	-0.42	0.06	0.09	-2.82	0.42
Income										
Poor	3.81	2.15	0.10	3.44	0.23	-0.23	0.02	0.04	-1.29	2.56
Non Poor	3.34	3.94	0.19	5.49	-0.34	-0.29	0.04	0.05	-1.55	2.52
Nepal	7.15	6.10	0.30	8.94	-0.11	-0.52	0.06	0.09	-2.84	5.09

Table 11: Impact of global maize trade liberalization (full reform) on household welfare in Nepal

Household Classification	Labor Effect	Supply Side Effect (%)		Demand Side Effects (%)					Welfare Effect	
							Cross Price Effect			
		Production	Own Price	Consumption	Income	Own Price	Wheat	Maize	Short Term	Long Term
Region										
Mountain	0.96	0.59	0.00	0.68	0.16	-0.01	0.00	0.00	-0.09	0.72
Hills	4.67	2.74	0.04	3.01	-0.08	-0.06	0.02	0.06	-0.27	4.50
Terai	2.81	0.79	0.02	0.59	-0.16	-0.02	0.00	0.00	0.20	3.21
Income										
Poor	2.78	1.93	0.03	2.40	0.11	-0.05	0.01	0.04	-0.47	2.23
Non Poor	5.66	2.19	0.03	1.87	-0.19	-0.03	0.01	0.02	0.32	6.20
Nepal	8.45	4.12	0.06	4.28	-0.08	-0.08	0.02	0.07	-0.16	8.42

owing from global rice trade liberalization. This result is similar to the one obtained by McMillan et al (2005) in cross-country regression. Welfare declines more among poor households than non-poor households in hills, but it is otherwise in case of terai and mountains. However, in Nepal as a whole, welfare declines more among poor households than non-poor.

Table 10 shows the effects of the global wheat trade liberalization on household welfare. In short-run, welfare declines for all categories of households. However, in the long–run, welfare increases in all categories of households except for those in mountains. Welfare among households in hills increases by 10 times more than those in terai. This implies that, in long-run, positive labor and supply effects offset the negative demand side effects among households in hills and terai. However, negative demand side effects offset positive labor and supply-side effects among households in mountains. Welfare increases slightly more among poor households than non-poor in treai, but it is otherwise in case of hills. In Nepal as a whole, welfare increases slightly more among poor households than non-poor.

Table 11 shows the effects of the global maize trade liberalization on household welfare**.** In short-run, household welfare declines in hills and mountains but it improves in terai. However, in the long-run, household welfare improves across all geographical regions. The results suggest that, in long-run, positive labor and supply effects offset the negative demand side effects among households in hills and mountains. Welfare improvement is largest among the households in hills followed by those in terai and mountains. Welfare increase is larger among non-poor households than poor ones across all geographical regions. In Nepal as a whole, welfare improvement among non-poor households is about three times larger than poor households.

6. Conclusion

The study examines the impact of global agricultural trade liberalization on household welfare in Nepal. They are examined in three steps. First, the study estimated the extent of price transmission from India (resulting from global agricultural trade liberalization) to domestic markets in Nepal's three hierarchical geographic regions - namely, the terai, hills and the mountains - for the selected agricultural products (rice, wheat and maize). Second, the study assesses the impact of change in local commodity prices on wages in different geographic regions by estimating price-wage elasticities. Finally, using these estimates, the proposed study simulates the short- and long-run impact of changes in Indian prices (rice, maize, wheat) resulting from global agricultural trade liberalization on household welfare in Nepal.

The basic story is that following global agricultural trade liberalization: (i) Nepal eventually experiences increase in domestic prices for rice, wheat, and maize with the extent of the transmission being highest in the border region terai, and the lowest in mountains which has poor transportation and communication infrastructure; (ii) for rice, household welfare declines in both short and long run because households are large net rice buyers and the negative demand side effects dominate positive supply side effects and labor effects; (iii) for wheat and maize, household welfare improves in the long-run because positive supply side effects offset negative demand side effects; and (iv) welfare change is relatively less favorable for poor than non-poor households as a result of change in world prices of rice and maize but it is otherwise in case of change in world price of wheat.

In conclusion, global agricultural liberalization has mixed effects on household welfare depending upon several factors including: (i) domestic price transmission; (ii) the extent of deficit of the commodity in question; and (iii) responsiveness of positive supply- vis-a-vis negative demand-side effects. The results of the study should be taken with following caveat. The study assumes: (i) fixed share of income derived from various crops implying that household do not respond to higher commodity prices; and (ii) zero cross-price effect on supply-side. For these reasons, household welfare gain on production side is underestimated. Accordingly, households will be better off from global agricultural trade liberalization than what the study allow.

The conclusion of the study has domestic policy implications. Poor countries like Nepal should realize that opening just the developed country markets will not be enough; the poor countries must generate the proper supply response by addressing its significant domestic or "behind –the-border" constraints and improving transport and communication infrastructure in rural side. In Nepal, sustaining and improving the agricultural sector's growth performance over the longer term will require emphasis on increasing farm productivity and agricultural marketing efficiency to strengthen farmer capacity to respond to growing domestic and international market opportunities. This will involve policy and regulatory reforms to reduce barriers to increased private sector participation and investments in the agricultural sector. It will require fostering increased public and private investments in rural infrastructure (roads, markets, electrification) and rural services (credit, agricultural research and extension, land administration, market information, export promotion, phsyto-sanitary services, grading and quality control). They should be supplemented by simplification of border-crossing procedure, which according to both formal and informal traders, have acted as an important obstacle to international trade (Karmacharya 2006). This would require simplifying the customs clearance procedure, licensing requirements, removing bottlenecks to transport, and investing in storage and border facilities in border posts.

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Appendix A
Policy Scenarios and Change in World Import Prices (%)

Author(s)	Policy Scenarios		Change in world prices (%)				
	Rich countries	Global	Paddy rice	Milled rice	Wheat	Maize	Sugarca
Bouet et al (2008)		Removal of DS, IT and ES		3	10.6		
Bouet et al (2005)		DS removal	8.2	0.6	1.4		
		IT removal	1.3	0.3	0.9		
		ES removal	0.1	0	0.1		
		Doha	9.4	1	2.3		
Diao et al (2002)	OECD DS removal			2.5	12.6	13.1	
		IT removal		6	3.5	1.4	
		ES removal		1.5	2.1	0.6	
	OECD DS removal	Removal of IT and ES		10	18.2	15.1	
Beghin et al (2002)	Removal of IT and ES		4.1		1.9	2.7	
	Removal of DS, IT & ES		5.5		12	14.5	
Fabiosa et al (2005)		Removal of IT and ES		10.7	7.6	**5.7**	
		Removal of DS, IT & ES		10.3	4.8	**6.2**	
Elbehri et al (2002)		ES removal		0.6	0.3	1.4	
		Removal of					

		DS, IT & ES		1.2	9.8	5.8	
UNEP (2005)	DS 50 % cut by OECD			8.5	6.1		
	DS removal by OECD			17	12.2		
Poonyth et al (2004)		US		2.5	11.9	4.4	
		EU		1	5.4	1.6	
		Harbinson		1.6	10.8	2.7	
Poonyth et al 2003					11.9		
Durand-Morat and Wailes 2003		Removal IT and ES		6.6 (low) 71.0 (med) 32.8 (all)			
Tokarich 2003		Full		2.3	3.9	3.1	
CARD 2002		IT&ES		9.8	6.4	**5.6**	
		Full		10.6	5.1	**6.8**	
Hoekman et al 2005		DS 40 % cut	6.3	-0.5	6.1	7.7	4
		40 % cut in bound tariff, reduction of tariff peak to a maximum of 50 %, ES removal and improved trade facilitation					
		Removal of DS and ES,	-2.7	-0.8	41.4	26.2	-1.12

		improved trade facilitation, & 50 % cut of restrictivenes of NTBs					
Hertel et al 2005		IT & DS cut, and ES removal	8.6		2.1	4.5	1.2
Hertel & Ivanic 2005		Global	22.2	7.7	9	12.2	
Winter 2005	IT cut, DS & ES removal by EU		1.6	1.8	2.2	2.6	1.3
ABARE 1999	Full sugar mkt lib in US; EU white sugar intervention prices reduced to world mkt level; and removal of import tariffs in Japan, Chin Mex, Skorea and Canada						41
Borrel et al 1999	Full reform in EU and US						20
		Full reform					38
FAO 1999	Full reform						
		Full reform					
Mensbrugghe et al 2003		Tariff removal					

GE PE		
Elobeid et al 2005	IT and ES removal Full reform	

Appendix B
Supply and demand parameters

Table B1: Area, Yield and Supply Elasticities with respect to price

	Area	Yield	Supply
Rice			
Mountains	0.06	0.26	0.32
Hills	0.06	0.19	0.25
Tarai	0.06	0.22	0.28
Wheat			
Mountains	0.18	0.12	0.3
Hills	0.18	0.16	0.34
Tarai	0.18	0.2	0.38
Maize			
Mountains	0.15	0.1	0.25
Hills	0.15	0.15	0.3
Tarai	0.15	0.17	0.32

Source: G.B. Thapa and M. Rosegrant, (1995), Projections and Policy Implications of Food Supply and Demand in Nepal to the Year 2020, Research Report Series No. 30, Winrock International.

Table B2: Estimated Demand Elasticities with respect to Price and Income by Income Class and by Ecological regions

	Own and cross-price elasticities			Income elasticities
	Rice	Maize	Wheat	
Mountains				
Low income (poor)				
Rice	-1.12	0.12	0.03	0.82
Maize	0.18	-1.02	0.08	0.35
Wheat	0.11	0.2	-1.2	0.63
High income (non-poor)				
Rice	-0.94	0.13	0.03	0.61
Maize	0.17	-0.76	0.08	0.15
Wheat	0.12	0.19	-0.98	0.41
Hills				
Low income (poor)				
Rice	-1.00	0.12	0.03	0.71
Maize	0.38	-0.91	0.09	0.05
Wheat	0.22	0.22	-1.13	0.47
High income (non-poor)				
Rice	-0.77	0.13	0.04	0.45
Maize	0.35	-0.61	0.08	-0.14
Wheat	0.23	0.19	-0.87	0.21
Tarai				
Low income (poor)				
Rice	-0.69	0.02	0.11	0.45
Maize	0.91	-1.12	0.24	-0.28
Wheat	0.77	0.04	-0.94	-0.08
High income (non-poor)				
Rice	-0.53	0.02	0.1	0.28
Maize	0.73	-0.87	0.18	-0.27
Wheat	0.64	0.03	-0.75	-0.13

Source: G.B. Thapa and M. Rosegrant, (1995), Projections and Policy Implications of Food Supply and Demand in Nepal to the Year 2020, Research Report Series No. 30, Winrock International.

Appendix C

Nature of Data and Their Sources

Price data

To analyze the transmission of changes in Indian border prices to domestic spatial markets in Nepal, the study uses both monthly and annual price data of rice, wheat, and maize for four Indian towns running along east to west across Nepal's southern border, including Purnia, Mujjaffurpur, Gorakhpur and Baharaich and for three geographical regions (terai, hills and mountains) of Nepal.

Price data for four Indian towns adjoining Nepal's southern border are obtained from Nepal Rastra Bank. They are available both on monthly as well as annual basis. The annual price data for four Indian towns are available for the period of 1979 – 2007. The monthly price data could be obtained only for the period August, 2004 to March, 2007.

Price data on domestic prices are obtained from Agricultural Marketing and Information Bulletin (various issues). They are collected for 59 among 75 total districts of Nepal. The geographical distribution of the 59 districts are as follows: i) 11 out of total 16 districts of mountain; ii) 31 out of total 39 districts of hill; and iii) 17 out of total 20 districts of Terai. The price data are available both on monthly as well as annual basis. The annual price data are available for the period of 1978 – 2007, except for maize for which the data is available only for the period of 1978-2000. The monthly price data is available for the period of May 1995 to March 2007, except for maize for which the data is available only for the period of May 1995 to April 2001.[9] The district level annual price data are averaged to generate the regional level annual price of rice, wheat, and maize weighted by quantity produced of the corresponding commodity in the district. Regional level monthly price is the simple average of district level monthly price data.

For price transmission analysis, the study has chosen the common time period during which price data for both Indian border town and domestic markets are available. Accordingly, price transmission analysis for rice and wheat are carried out by using annual price data for the period of 1978-2007 and monthly data for the period of August 2004 to March 2007. Likewise, price transmission analysis for maize is carried out by using only annual price data for the period of 1978-2000.

Household level survey data

Nepal Living Standard Survey (NLSS 2003/04) is used to calculate θ's for individual goods g, such as rice, maize, and wheat . NLSS data was also used to estimate price-wage elasticities. NLSS is the nationally random cross-section sample of 4008 households from six explicit strata of the country. The geographic distribution of cross-section section sample with respect to geographical regions are as follows: mountains (408 households); hills (1968 households); and terai (1632 households). In terms of urban/rural composition, they are as follows: (i) urban (1164 households); and rural (2844 households). But, 2256 of total 4008 households only have wage labor individual which is required to estimate the earning equation so the study has just used

[9] The price of wheat is also missing from 2001 onward however the bulletin has record of wheat flour which has been used to derive wheat price level using conversion factor as mentioned by the bulletin.

2256 household to maintain consistency in each level of analysis. The geographical distribution of these 2256 households are as follow: mountain (206 households); hill (961 household) and terai (1089 household). In terms of urban/rural composition, they are as follows: (i) urban (726 households); and rural (1530 households).