1. Introduction

Food security in agriculture-based countries cannot be discussed without considering agricultural development (World Bank, 2007). Agriculture plays an important role in the food security of developing countries, which is mostly assisted by subsistence farming.

There are different approaches to analyzing food security: food availability, income-based, basic needs, entitlement, and sustainable livelihood. The income-based approach is used for analyzing poverty in developing countries and it is more effective in analyzing countries operating an ideal economy. However, this method is not highly reliable in low-income countries wherein subsistence agriculture is dominant (Burchi and De Muro, 2015).

In analyzing food security in subsistent rural areas, the concept of entitlement approach (Sen, 1981) is important. Entitlement includes two components: (1) endowment, which is initial ownership (e.g., labor force, holding land), and (2) exchange, which means that individuals can acquire alternative goods through exchange with others or nature (Dreze & Sen, 1989, 10-11). Farmers can produce crops by exchanging their land and labor with nature. If a farmer's right to nature is damaged by some unfavorable situation (e.g., illness, loss of employment, rise in food price), it is called "entitlement failure." Concepts such as these emphasize the importance of self-sufficient agriculture in food security.

Improvements in agricultural productivity contribute to the reduction of poverty (Datt and Ravallion, 1998; Hanmer and Naschold, 2000; Irz and Roe, 2000; Irz et al., 2001; Janvry and Sadoulet, 2009; Thirtle et al., 2001; Woden, 1999; World Bank, 2007). In addition, agricultural productivity influences food poverty (Block, 1995; Mainuddin and Kirby, 2009; Ogundari and Awokuse, 2016).

Agricultural productivity affects the level of poverty in Nepal (Devkota and Upadhyay, 2013); however, in reaching this conclusion, labor productivity was assumed as agricultural productivity. However, labor productivity measures only the efficiency of labor input and disregards other production factors and productivity improvement independent of physical resource inputs.

In this paper, we present the effect of agricultural productivity on agricultural workers' food consumption, which is a focus that has an opposite relation with that of preceding studies. Considering that an increase in agricultural output is directly connected with a farmer's income, we cannot underestimate the influence of agricultural productivity on human capital. This paper has three primary aims. First, we identify the Total Factor Productivity (TFP) of agriculture in Nepal as an index of overall agricultural productivity. Second, we quantify the impact of agricultural production on household food security. Third, we use the panel datasets of the NLSS from 1995/96 and 2003/04. Using panel data enable us to eliminate heterogeneity, such as consumption patterns at the household level, land condition in agricultural production, and access to markets for buying inputs and selling outputs. Specifically, each household has a food consumption pattern that is determined not only by its preferences but also by its level of income. However, we limit the discussion of the effect of human capital on agricultural productivity, as with previous research. In addition, we do not exclude landless laborers, who are regarded as the poorest people in Nepal. In this paper, we investigate farmers in Nepal in their entirety.

2. Overall condition in Nepal

Nepal is a landlocked country bordered to the north by China and to the south, east, and west by India. Nepal is commonly divided into three ecological belts: the Mountain belt, Hill belt, and Terai belt, in order of decreasing height above sea level. The Terai belt is a fertile, humid, and flat agricultural strip. In addition, Nepal is divided into five development regions that cut across these ecological belts: Eastern Development Region, Central Development Region, Western Development Region, Mid-Western Development Region, and Far-Western Development Region.

A high percentage—as much as 66.5% in 2013—of the Nepalese workforce is engaged in agriculture, although agriculture's share of GDP is only about 35%. This implies that agriculture remains a key economic activity and a source of basic income for the majority of the population in Nepal. Meanwhile, rapid population growth has caused a decline in land-holding area per person across the country, except in the Mountain belt (Table 1). Of all the regions, the Far-Western Development Region has exhibited the smallest land-holding size for at least the past 20 years. High population density and limited cultivable area have led to severe land fragmentation. Almost 75% of households have holdings of less than one hectare, which is inadequate to meet their subsistence needs (Central Bureau of Statistics [CBS], 2004). The CBS (2005) reported the average income per person according to income resources between 1995 and 2003. Remittances and income from non-agricultural sectors have shown an increasing trend. On the other hand, income from the agricultural sector either stagnated or decreased between 1995 and 2003. Therefore, the agricultural sector has grown sluggishly despite being a major income source for the Nepalese population.

The CBS (2005) reported changes in the head-count poverty ratio using both cross-section and panel data collected by the NLSS carried out in 1994–95 and 2003–04. The cost-of-basic-needs method was used to define the poverty line. The national poverty ratio in 1995–96 was estimated at about 42%, while that for 2003–04 was estimated at about 31%. However, the gains in poverty reduction stem from urban areas. Poverty declined only 20% within rural areas, compared with a 56% decline in urban areas. We can confirm the trend of substantial poverty decline in Nepal, but poverty reduction is focused on only certain segments of the poor. The CBS (2005) also measured the food poverty line prior to expenditure on food and non-food goods because non-food expenditures tend to contain many "noisy" purchases that induce measurement bias, such as the flow of durable goods, as pointed out by Lanjouw and Lanjouw (2001). Therefore, food consumption might be regarded as a substitute for their livelihood or the poverty ratio.

Moreover, the CBS (2005) reported an increase in the agricultural wage rate and poverty alleviation among agricultural employed laborers. They concluded that out-migration and availability of job opportunities in agricultural wage employment accompanied by out-migration stimulated a rise in the agricultural wage rate, which benefitted agricultural wage laborers, who tend to be the poorest population segment in the Nepal. Conversely, the World Bank (2006) reported a stagnation in agricultural income because of higher input costs and lower output prices in the crop sector. However, neither of these reports paid particular attention to agricultural growth or productivity in Nepal.

In this paper, we opt to use panel datasets to measure agricultural TFP and estimate the impact of agricultural revenue upon household food security. We choose not to measure poverty level considering both food and non-food goods because the panel datasets are not only missing many values but also exclude some education data. Nonetheless, it is difficult to compare food expenditure across households because each household has a particular food consumption pattern. However, we could subtract a household's particular pattern of not only food consumption but also heterogeneity caused by a household's unique characteristics or agricultural land condition.

Devkota and Upadhyay (2013) estimated agricultural productivity using the Cobb–Douglas and translog production functions to quantify productivities' effect on poverty reduction. They then identified the determinants of agricultural productivity that affect poverty reduction. They also measured productivity as output per worker and determined that the translog production model fits the Nepalese data better than the Cobb–Douglas model. Then, they used the translog production function to investigate the impact on poverty through the determinants of productivity. Their results indicate that a favorable change in the fundamental determinants of crop income, such as area, fertilizers, or investments, will lead to a drop in poverty. Moreover, an integrated effect from a change in all covariates of productivity is larger than the effect produced by any one factor in isolation. Their findings imply that policies supporting comprehensive productivity-enhancing factors will lead to a decrease in poverty. However, land and labor productivity depend on various factors, such as the nature of soil, land condition, level of market maturity, and so on, which can be difficult to manipulate.

3. Data Sources and Methodology

Data

The data were obtained from the NLSS 1995–96 and 2003–04 (NLSS-I and NLSS-II) carried out by Nepal's CBS. NLSS-I and NLSS-II are based on nationally representative surveys of households and communities that consist of cross-sectional and panel datasets. This survey follows the World Bank in using the Living Standard Measurements Study methodology and utilizes a two-stage sample design selection method. The panel data include 962 households, which were also interviewed in NLSS-I, from 95 panel Primary Sample Units. The survey's questionnaire contains broad information, including detailed income and consumption data and household-specific social and economic information. Households with positive numbers for crop production include 748 households in

NLSS-I and 740 households in NLSS-II. These datasets in 1995 and in 2003 do not merge perfectly for several reasons: (i) the head of the household may have changed because of a death in the family, working out, a household split, and so on and (ii) there are single-year data related to agricultural production, because households might have left or entered into agriculture production during the eight years between surveys. Moreover, We have eliminated data with outlying observation. Therefore, the dataset consists of 503 households, which are summarized in Table 2.

Table 2 shows expenditure on farming, agricultural revenue, and food consumption levels for 1995 and 2003 as evaluated in 1995 values. Food consumption is determined as the food expenditure per person: total household food expenditure divided by number of household members converted into adults. Food consumption is calculated by adding expenditures on home-produced foods, purchased foods and foods received in kind. We have calculated food prices from purchased foods' expenditure divided by its amount.

This study does not focus especially on landless agricultural wage labors, despite their being the poorest segment of the Nepalese population; this is because of the employed methodology of measuring the effect of agricultural productivity via food consumption. In this paper, we limit ourselves to households with positive agricultural production in both 1995 and 2003. Then, we estimated the effect of agricultural productivity on food consumption at the household level.

Measuring Total Factor Productivity and Regressing Food Consumption

TFP is the part of output that cannot be explained by the amount of inputs used in production. We will show the consistency of TFP. We set output quantity vectors as $y^t \equiv (y_1^t, \dots, y_m^t)$, where $p^t \equiv (p_1^t, \dots, p_m^t)$ is the output price vectors, and input quantity vectors as $x^t \equiv (x_1^t, \dots, x_m^t)$, where $w^t \equiv (w_1^t, \dots, w_m^t)$ is the input price vectors related to period t, for $t = 0, 1$. We denote the base period as period 0 and the target period as period 1. The Fisher ideal output and input quantity indices are defined as

$$F_y\left(\boldsymbol{p}^{0,1},\boldsymbol{y}^{0,1}\right)\equiv\left(\frac{\boldsymbol{p}^0\cdot\boldsymbol{y}^1}{\boldsymbol{p}^0\cdot\boldsymbol{y}^0}\cdot\frac{\boldsymbol{p}^1\cdot\boldsymbol{y}^1}{\boldsymbol{p}^1\cdot\boldsymbol{y}^0}\right)^{1/2}$$

$$F_q\left(\boldsymbol{w}^{0,1},\boldsymbol{x}^{0,1}\right)\equiv\left(\frac{\boldsymbol{w}^0\cdot\boldsymbol{x}^1}{\boldsymbol{w}^0\cdot\boldsymbol{x}^0}\cdot\frac{\boldsymbol{w}^1\cdot\boldsymbol{x}^1}{\boldsymbol{w}^1\cdot\boldsymbol{x}^0}\right)^{1/2}$$

respectively.

Changes in productivity are usually expressed as the output ratio divided by input ratio using Fisher ideal quantity indices, which are aggregate output and input goods. The Fisher ideal TFP index is expressed as the ratio of aggregate output to aggregate input

$$F_{TFP}\left(\boldsymbol{p}^{0,1},\boldsymbol{y}^{0,1},\boldsymbol{w}^{0,1},\boldsymbol{x}^{0,1}\right)\equiv\frac{F_y\left(\boldsymbol{p}^{0,1},\boldsymbol{y}^{0,1}\right)}{F_q\left(\boldsymbol{w}^{0,1},\boldsymbol{x}^{0,1}\right)}.$$

In this paper, period $t=0$ is 1995 and period $t=1$ is of 2003; $y^t\equiv(y_1^t,y_2^t)$ is the output quantity, where y_1 is the sum of outputs in crop sector. Similarly, y_2 is the sum of earnings from livestock sector; $p^t\equiv(p_1^t,p_2^t)$ is output factor prices, where p_1 includes 66 kinds of crop prices, and p_2 includes 6 kinds of animal product prices. Moreover, $x^t\equiv(x_1^t,x_2^t,x_3^t,x_4^t\,x_5^t)$ is the input quantity where x_1 is the input of labor-days, x_2 is the input of cultivated land area, and x_3 is the input quantity of fertilizers. Furthermore, x_4 is the input of insecticide, and x_5 is the input of purchased seeds. The questionnaire does not consider young plants to have input quantity information. Therefore, instead of input quantities, we use total expenditure costs adjusted in real terms by the consumer price index (CPI). In addition, $w^t\equiv(w_1^t,w_2^t,w_3^t,w_4^t\,w_5^t)$ is the input price, where w_1 is agricultural wage rate, w_2 is land rent per hectare, and w_3 includes prices for three kinds of fertilizers; however, w_3 and w_4 express the prices of insecticide and seeds, respectively, only in theory.

Table 3 and Table 4 show the variables used to generate TFP. We evaluate output and input goods in nominal terms and real terms, respectively. The price is calculated from cross-sectional data in NLSS-I and NLSS-II because they have larger sample sizes than the panel dataset. We calculate unit prices by taking the median of unit output price or unit input cost calculated from the household reported data. We could not calculate unit prices for insecticide, seeds, and young plants, or livestock earnings from the NLSS datasets. Therefore, we used the CPI reported by Nepal Rastra Bank (2006) or the price index reported from the Agri-Business Promotion and Statistics Division (ABPSD, 1995–96, 2012–13) to adjust prices in lieu of nominal and real prices. Crop output has been totaled for each crop output and is expressed by each crop unit's price in nominal and real terms. Earnings from livestock containing meats, eggs, and some dairy products are adjusted by ABPSD (1995–96, 2012–13).

Cultivated land area is the sum of owned, rented, mortgaged, and sharecropped land area. Land rent was calculated from median land rent received per hectare as reported by landlords. We then estimated the value of the cultivated land area in both nominal and real terms. The value of invested labor work-days is the sum of family labor and employed labor. Its unit price was derived from the median of agricultural wage payments per work-days reported by employers. Fertilizer was calculated using the input quantity multiplied by the unit price of each fertilizer type. Fertilizer unit prices are medians of fertilizer expenditures divided by purchase quantities. Insecticide, seeds, and young plants use the raw expenditure data, which were then adjusted in real terms using CPI reported data from Nepal Rastra Bank (2006).

Thus, we calculated the Fisher quantity index for both output and input. Table 5 shows the details for the Fisher TFP. Comparing the log of TFP information in Table 5, the Mountain and Hill belts grew approximately 20 to 30 % during the specified eight years. The Western Development Regions had grown considerably compared with other development regions. However, recession or no change occurred in the Terai belt (–6.3%), meaning that agricultural productivity in 2003 in the Terai belt is almost same as its agricultural productivity in 1995. The Far-Western Development Region could be also stagnant (–2.7%).

This might be due to the fact that agricultural productivity in the Terai belt had already risen by 1995. However, the Western and Mid-Western Development Regions largely showed growth from 1995 to 2003. The high TFP levels in these development regions were not influenced so much by production growth for the eight specified years as by their low level of technology in 1995, since the western area of Nepal lacked infrastructure development.

Food consumption levels and Ordinary Least Squares regression

The increase in TFP cannot be explained by that of input. The following equation shows the Cobb–Douglas production function,

[equation.pdf]

$$Y = A\boldsymbol{x}^{\boldsymbol{\alpha}}$$

"Y" is the agricultural output, "vector x" is a bundle of production factors, and "A" is the TFP. Taking the log of both sides,

[equation.pdf].

$$\log Y = \log A + \boldsymbol{\alpha} \log \boldsymbol{x}$$

If we estimate this equation model, its intercept is the growth of TFP. Therefore, using the Cobb–Douglas production function, we estimate the growth of TFP between 1995 and 2003.

Y_t and Y_{t+1} represent agricultural outputs in t and $t+1$ terms, respectively. Taking the ratio of the two terms,

[equation.pdf]

$$Y_t = A_t \boldsymbol{x}_t^{\boldsymbol{\alpha}}$$

$$Y_{t+1} = A_{t+1} \boldsymbol{x}_{t+1}^{\boldsymbol{\alpha}}$$

$$\frac{Y_t + 1}{Y_t} = \frac{A_{t+1}}{A_t} \left(\frac{\boldsymbol{x}_{t+1}}{\boldsymbol{x}_t} \right)^{\boldsymbol{\alpha}}$$

Taking the log of both sides, the equation is expressed as follows.

[equation.pdf]

$$\Delta \log Y = \Delta \log A + \boldsymbol{\alpha} \Delta \log \boldsymbol{x} \quad (1)$$

$\Delta \log A$ represents the change in TFP. In our analysis, "Y" is the agricultural output based on 1995 prices. Input goods are labor, fertilizer, pesticide, and seed. Labor is measured as man-days multiplied by average wage using the 1995 prices calculated from the NLSS cross section data. Fertilizer, pesticide, and seed represent the expenditure in 1995 prices calculated from the NLSS cross section data. However, input of fertilizer, pesticide, and seed is low; therefore, the bundle of inputs (vector x) is the sum of these inputs' real amount using 1995 prices. Dummy variables of the three ecological belts and five development regions are also added.

We estimate the change of agricultural productivity in Nepal. We also estimate the effect of agricultural production and productivity on food consumption.

[equations.pdf]

$$\begin{aligned}\log\left(\frac{FC^{03}_{95p}}{FC^{95}_{95p}}\right) &= \beta_0 + \left(\beta_1+\gamma_1 FC^{95}_{95p}\right)\log\left(\frac{Y^{03}_{95p}}{Y^{95}_{95p}}\right)\\ &+\left(\beta_2+\gamma_2 FC^{95}_{95p}\right)\left(otherINC^{03}_{95p}-otherINC^{95}_{95p}\right)\\ &+\left(\beta_3+\gamma_3 FC^{95}_{95p}\right)\left(remit.^{03}_{95p}-remit.^{95}_{95p}\right)\\ &+\beta_4\left(family^{03}-family^{95}\right)+\beta_5 FC^{95}_{95p}\end{aligned}$$

The change of food consumption represents the log of ratio of the two periods' expenditure on food per year, per person in 1995 prices. The food consumption consists of 39 food items, the prices of which are calculated from food purchase records in the NLSS's annual cross-section data. Using these derived prices, we re-evaluate food consumption quantity for each year, with the subscript denoting a price for the food item for re-evaluation and the superscript indicating the quantity of food consumed each year. The sum of food consumed by a household is divided by household size, which in turn is converted in energy requirements for different ages and genders. Family members indicate changes in household size based on nutrient requirements. Income from other sources as well as the number of consumers, both influence food consumption. Income is treated separately and it is divided into self-employment in agriculture, other income (wage employment in agriculture and non-agriculture, and self-employment in non-agriculture), and remittances. The agricultural output growth represents the log of ratio of the two periods' agricultural gross revenue in 1995 prices. It serves as a proxy variable of changes in proportion of agricultural output. Other income is calculated as the sum of income from being wage-employed in the agricultural sector and wage income from jobs in both agricultural and non-agricultural sectors. We take a difference of other income and remittance in two terms because they have many zero values in each period.

[equations.pdf]

$$
\begin{aligned}
\log\left(\frac{FC_{95p}^{03}}{FC_{95p}^{95}}\right) &= \beta_0 + \left(\beta_1 + \gamma_1 FC_{95p}^{95}\right)\log\left(\frac{Y_{95p}^{03}}{Y_{95p}^{95}}\right) \\
&\quad + \left(\beta_2 + \gamma_2 FC_{95p}^{95}\right)\Delta\left(otherINC\right) \\
&\quad + \left(\beta_3 + \gamma_3 FC_{95p}^{95}\right)\Delta\left(remit.\right) \\
&\quad + \beta_4\Delta\left(family\right) + \beta_5 FC_{95p}^{95}
\end{aligned}
$$

where

$$
\begin{aligned}
\Delta\left(otherINC\right) &= otherINC_{95p}^{03} - otherINC_{95p}^{95} \\
\Delta\left(remit.\right) &= remit._{95p}^{03} - remit._{95p}^{95} \\
\Delta\left(family\right) &= family^{03} - family^{95}
\end{aligned}
$$

We consider the interaction between the food consumption level in 1995 and the change in income. In other words, if a household did not have sufficient food in 1995, they will try to increase their income. For example, a member of the household may search for work in non-agricultural sectors, migrate to other regions or countries, or try to enhance the agricultural output. Income elasticity of food demand is higher for the poor. Moreover, if households are provided with enough food, food demand would be inelastic. In order to study the impact of agricultural output growth by household in the 10^{th} to 90^{th} percentile values of food consumption in 1995, we estimate equation (2) as follows.

[equations.pdf]

$$
\begin{aligned}
\log\left(\frac{FC_{95p}^{03}}{FC_{95p}^{95}}\right) &= \beta_0 + \left\{\beta_1 + \gamma_1\left(FC_{95p}^{95} - pctP_{FC_{95p}^{95}}^{th}\right)\right\}\log\left(\frac{Y_{95p}^{03}}{Y_{95p}^{95}}\right) \\
&\quad + \left\{\beta_2 + \gamma_2\left(FC_{95p}^{95} - pctP_{FC_{95p}^{95}}^{th}\right)\right\}\Delta\left(otherINC\right) \\
&\quad + \left\{\beta_3 + \gamma_3\left(FC_{95p}^{95} - pctP_{FC_{95p}^{95}}^{th}\right)\right\}\Delta\left(remit.\right) \\
&\quad + \beta_4\Delta\left(family\right) + \beta_5\left(FC_{95p}^{95}\right) \\
&= \beta_0 + \beta_1\log\left(\frac{Y_{95p}^{03}}{Y_{95p}^{95}}\right) + \gamma_1\left(FC_{95p}^{95} - pctP_{FC_{95p}^{95}}^{th}\right)\cdot\log\left(\frac{Y_{95p}^{03}}{Y_{95p}^{95}}\right) \\
&\quad + \beta_2\Delta\left(otherINC\right) + \gamma_2\left(FC_{95p}^{95} - pctP_{FC_{95p}^{95}}^{th}\right)\cdot\Delta\left(otherINC\right) \\
&\quad + \beta_3\Delta\left(remit.\right) + \gamma_3\left(FC_{95p}^{95} - pctP_{FC_{95p}^{95}}^{th}\right)\cdot\Delta\left(remit.\right) \\
&\quad + \beta_4\Delta\left(family\right) + \beta_5\left(FC_{95p}^{95}\right) \qquad (2)
\end{aligned}
$$

where $FC_{95p}^{95} - pctP_{FC_{95p}^{95}}^{th}$ indicates the difference between food consumption level in

1995 and P^{th} percentile value. Similarly, pct10th/pct25th/pct50th/pct75th/pct90th refer to the corresponding percentile values in the equation. Y represents for agricultural gross revenues, while FC represents food consumption. Finally, Δ defines the difference between 2003 and 1995 values.

However, we use the two-stage least squares methods because of the endogeneity of agricultural output. Further, we use the TFP estimator from Eq. (1) as the instrumental variables. TFP can be likened to "manna from heaven," and is generated from the exchange of nature for human activity. TFP is the adequate exogenous variable for food consumption. The details of each variable are presented in Table 6 and Table 7. The result of Eq. (1) is shown in Table 8. The result of the first and the second stage in Eq. (2) is shown in Table 9.

4. Results

The row (1) in Table 8 shows the result of Eq. (1), which is the estimation result for all of Nepal. It reveals that TFP had grown about 11.4% in eight years. This is not much different from the value of l_TFP in Table 5. The annual rate is about 1.4 % and is calculated as follows: $(1+0.1139)^{1/8} \approx 1.0136$. The constant in Table 8 (1) shows Total Factor Productivity (TFP) in Nepal. The model in Table 8 (2) informs about the relative size of each region's TFP. We confirm the same tendency in Table 5: TFPs in Terai belt have declined, while TFPs in Mid– and Far-Western Development Regions have increased.

In order to analyze the impact of agricultural output on food consumption, we estimate a two–stage least–squares model using each household's $\widehat{TFP}$ from Table 8 (1) as an instrumental variable in Table 9. When we regress the growth in food consumption on the growth in agricultural gross revenue only (Table 9 (1)), the impact of agricultural production is about 0.0799. As per Table 10, the average growth in agricultural gross revenue between 1995 and 2003 is about 23%, implying a growth in food consumption by 23% * 0.0799=1.8%. In average terms, such a growth is 3.9% between 1995 and 2003. Therefore, agricultural gross revenues contribute to food consumption for 1.8%/3.9% = 46% on average. Moreover, the lower the income level in 1995, the higher the positive impact of agricultural production on food consumption. Figure 1 shows the presumably negative relationship between growth in food consumption and food consumption level in

1995. Then, using equation (2), we attempted to estimate the impact of agricultural production by food consumption level in 1995.

By taking 1995 as the reference year, we estimate the impact of agricultural production on food consumption. Specifically, Table 10 shows the 10^{th} to 90^{th} percentiles of food consumption. Then, over the range of the observed food consumption levels in 1995, coefficients of agricultural output growth (i.e., log(Agr. GR in 2003 / Agr. GR in 1995)) in Table 9 (2)–(6) tend to decrease. The impact of average agricultural output growth on average food consumption for each percentile is showed in Table 10.

As can be seen in Table 10 (4), the average agricultural output growth contributes to about 40% of food consumption growth among households in the 10^{th} percentile. The impact over the 50^{th} percentile is smaller, although the coefficients are not significant. In other words, this result suggests that poorer households achieve food consumption growth from agricultural output growth.

Moreover, self-consumption accounts for a large proportion of the food consumption of peasants. Figure 2 and Table 11 shows the ratio of self-consumption, purchase, and in-kind, to total food consumption in NLSS-I, -II, and -III's cross-section data. In this context, a farmer is defined as an individual who cultivates his own land or a rented land. Farmers have a larger proportion of self-consumption than non-farmers.

5. Conclusion

This study mainly focused on the effects of changes in agricultural production on food consumption levels. However, such previous papers based on the efficiency wage hypothesis have largely not considered factors explaining productivity, except nutrient intake. Devkota and Upadhyay (2013) measured the effect of agricultural labor productivity on poverty alleviation in Nepal. However, their measurement used cross-section data, in which it is difficult to control for heterogeneity. Improvements in labor productivity lead to a similar discussion on improvements in inputs such as fertilizers because farmers' production points shift along the one production function they estimated. They could not consider the efficiency of inputs to outputs such as TFP, in which increases are expressed in shifts of the production function itself. Our paper has clarified some of the essential effects of income elasticity by using NLSS panel data on Nepal from 1995 to 2003, together with a straightforward statistical analysis using OLS. Before clarifying the relationship identified in this study, we calculated the agricultural TFP in Nepal and confirmed the present status of agricultural production in Nepal. We found the following two points through our analysis in this paper.

First, the TFP of agriculture in Nepal increased between 1995 and 2003, although previous surveys reported stagnation of agricultural productivity caused by land fragmentation. We have calculated the Fisher TFP index, which is the microscopic approach. Moreover, the TFP we estimate from the Cobb-Douglas form, which is the macroscopic approach. The TFP is almost the same in both the Fisher TFP or when using the Cobb-Douglas production function.

Second, people with lower food consumption levels are more positively impacted by enhancements to agricultural production. The effect on food consumption from the result of estimation may seem little; however, it is as a result of the insignificant change in the food consumption level of those who had adequate food in 1995. Agriculture has adequately explained food consumption. Moreover, farmers' food consumption is dependent on self-production. It is important for the food security of farmers that they cultivate themselves and receive agricultural products in kind. The "westward" area of Nepal is especially known to have poor social and economic conditions due to political disputes. These findings highlight the importance for subsistence households to enhance their agricultural production or income in order to safeguard their household's food security.

The analysis in this paper has some limitations and problems to be solved in future studies. We need to analyze TFP itself, especially in terms of placing emphasis on variations in initial conditions across environmental zones. Such an analysis would reveal the factors underlying different agricultural productivity at the regional level. Both the World Bank (2006) and Devkota and Upadhyay (2013) report that land and labor productivity in the agricultural sector have slumped, although neither study measures or estimates specific changes in agricultural productivity. We expect our ongoing research using panel datasets to obtain an objective picture of the present condition will reveal the factors underlying this developmental trough.

References

Agri-Business Promotion and Statistics Division (ABPSD) 1995/96, *Statistical information on Nepalese agriculture 1995/96*, Kathmandu: Ministry of Agricultural Development.

Block, S. A., 1995. "The recovery of agricultural productivity in sub-Saharan Africa." *Food Policy*, 20(5), pp. 385–405.

Burchi, F. and De Muro, P., 2016. "From food availability to nutritional capabilities: advancing food security analysis." *Food Policy*, 60, pp. 10–19.

Agri-Business Promotion and Statistics Division (ABPSD) 2012/13, *Statistical information on Nepalese agriculture 2012/13*, Kathmandu: Ministry of Agricultural Development.

Central Bureau of Statistics (CBS) 2005, *Poverty trends in Nepal (1995-96 and 2003-04)*, Kathmandu: CBS.

Datt, G. and Ravallion, M., 1998. "Farm productivity and rural poverty in India." *J Dev Stud*, 34(4), pp. 62–85.

Diewert, WE 1992, "Fisher ideal output, input, and productivity indexes revisited", *J Dev Anal*, 3(3), pp. 211–248.

Devkota, S & Upadhyay, M 2013, "Agricultural productivity and poverty reduction in Nepal ", *Review of Development Economics*, 17(4), pp. 732–746.

Dreze, J. and Sen, A., 1989. *Hunger and public action*. New York: Oxford University Press on Demand.

Hanmer, L. and Naschold, F., 2000. "Attaining the international development targets: will growth be enough?" *Dev Pol Rev*, 18, pp. 11–36.

Irz, X. and Roe, T., 2000. "Can the world feed itself? Some insights from growth theory." *Agrekon*, 39(4), pp. 513–528.

Irz, X. and Lin, L., Thirtle, C. and Wiggins, S., 2001. "Agricultural productivity growth and poverty alleviation" *Dev pol rev*, 19(4), pp. 449–466.

Lanjouw, JO & Lanjouw, P 2001, "How to compare apples and oranges: poverty measurement based on different definitions of consumption", *Rev of Income and Wealth*, 47(1), pp. 25–42.

Mainuddin, M. and Kirby, M., 2009. "Agricultural productivity in the lower Mekong Basin: trends and future prospects for food security" *Food Security* (1), pp. 71–82.

Nepal Rastra Bank (NRB) 2006/07. *Economic Report 2006/07*, Kathmandu: NRB

Ogundari, K. and Awokuse, T., 2016. Assessing the Contribution of Agricultural Productivity to Food Security levels in Sub-Saharan African countries. *Agricultural and Applied Economics Association 2016 Annual Meeting*.

Thirtle, C., Beyers, L., Lin, L., Mckenzie-Hill, V., Irz, X., Wiggins, S. and Piesse, J., 2002. "The impacts of changes in agricultural productivity on the incidence of poverty in developing countries", *DFID report,* 7946.

Wodon, Q., 1999. Growth, poverty, and inequality: a regional panel for Bangladesh *World Bank Publications.*

World Bank 2006, *Nepal - Resilience amidst conflict: an assessment of poverty in Nepal, 1995-96 and 2003-04*, Washington, DC: World Bank.

World Bank 2007, *World Development Report 2008 : Agriculture for Development*, Washington, DC: World Bank.

Table 1 Population of farmers and land segmentation in Nepal

Classification		*No. of persons ('000)*			*Area of land holdings ('000 ha)*			*Segmentation*		
		1981/82	*1991/92*	*2001/02*	*1981/82*	*1991/92*	*2001/02*	*1981/82*	*1991/92*	*2001/02*
Ecological Belt	Mountain	1097.5	1446.6	1569.8	122.6	176.8	218.7	0.112	0.122	0.139
	Hill	6022.6	7747.9	8601.4	939.7	1046.2	1038.6	0.156	0.135	0.121
	Terai	5757.6	7063.6	8861.2	1401.4	1374.3	1396.6	0.243	0.195	0.158
Development Region	Eastern	3398.4	3712.8	4280.2	771	783.2	795.5	0.227	0.211	0.186
	Central	4160.2	5061	5970.9	823.3	719.7	750.2	0.198	0.142	0.126
	Western	2,635.20	3618	4009	463.6	566.4	512.1	0.176	0.157	0.128
	Mid-Western	1,634.40	2242.7	2714.5	258.2	324.7	370.7	0.158	0.145	0.137
	Far-Western	1049.3	1623.8	2057.8	147.6	203.3	225.4	0.141	0.125	0.110

Source: The authors prepared the table using the data from

Agricultural Monograph Final, pp. 9–10, 16–17

TABLE 1.7: CHARACTERISTICS OF POPULATION AND HOLDINGS BY ECOLOGICAL BELT, 1981/82, 1991/92 AND 2001/02

TABLE 1.8: CHARACTERISTICS OF POPULATION AND HOLDINGS BY DEVELOPMENT REGION,1981/82 TO 2001/02

TABLE 2.2: NUMBER AND AREA OF HOLDINGS BY ECOLOGICAL BELT, 1981/82,1991/92 AND 2001/02

TABLE 2.3: NUMBER AND AREA OF HOLDINGS BY DEVELOPMENT REGION, 1981/82, 1991/92AND 2001/02

Table 2 Summary of an annualized farm household

		Agricultural input (Rs.)		*Agricultural output (Rs.)*		*Food expenditure (Rs.)*		*Food Poverty (households)*	
Regions	*N*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*
Kathmandu	5	14,238	15,158	15,058	16,086	3,390	4,240	4	4
Other urban area	23	12,247	14,966	18,975	29,056	5,675	5,149	6	53
Rural eastern Hill	155	23,802	22,145	19,100	19,831	5,640	4,841	33	12
Rural eastern Terai	121	24,387	26,024	34,084	33,021	5,218	5,978	7	53
Rural western Hill	136	18,054	16,367	11,051	14,637	4,626	5,434	67	8
Rural western Terai	63	27,616	27,365	33,441	38,286	6,230	5,337	4	8
Mountain	74	23,527	20,979	13,245	16,252	4,683	4,693	31	28
Hill	236	19,712	18,277	15,916	17,704	5,372	5,279	75	88
Terai	193	24,845	26,349	33,523	35,440	5,493	5,676	15	24
Nepal	503	22,243	21,772	22,279	24,296	5,317	5,345	382	121

Source: Nepal Living Standard Survey-I and -II

Note: Prices are from 1995.

We have eliminated data with Fisher index of output (Fy) less than 0.1 and more than 5, and Fisher index of input (Fq) less than 0.1 and more than 5

Food poverty is the number of households under food poverty line from NLSS(2005, p56. Table 2.3.1)

Table 3 Description of TFP components

	Quantity	*Unit price*	*Definition*
Output	Crops (y_1)	Each median of crop unit price by respective unit including 66 kinds of crops. (p_1)	Gross revenue of production aggregate 66 kinds of crops. Self-consumption is also valued (NRs. 1000)
	Livestock (y_2)	Price adjustment by price index from ABPSD instead of calculating p_2.	Gross revenue of livestock products, such as meat, dairy products, and animal hide (NRs. 1000)
Input	Labor man-day (x_1)	agricultural wage rate per man-day. (w_1)	Evaluated value of man-days of family labor and hiring labor for agricultural production evaluated by agricultural wage rate (NRs. 1000)
	Cultivated area (x_2)	Median of land rented-out per ha. (w_2)	Estamated value of sum of owned land area and rented-in land area (NRs. 1000)
	Fertilizer purchased quantity (x_3)	Each median of fertilizer price per kg including 4 kinds of fertilizer. (w_3)	Total purchase amount of fertilizer (NRs. 1000)
	Insecticide purchased quantity (x_4)	Price adjustment by CPI instead of calculating p_4	Total purchase amount of insecticides (NRs. 1000)
	Seed purchased quantity (x_5)	Price adjustment by CPI instead of calculating p_5	Total purchase amount of seeds. (NRs. 1000)

Note: The unit price is in real term.

The NLSS questionaire includes 67 kinds of crops. However, "other trees" is excluded because we could not calculate its price because of data scarcity.

We created the Laspeyres Paasche quantity index for both output and input.

Table 4 Details of explanatory variables in the regression

				Belt						*Development region*									
		Nepal		*Mountain*		*Hill*		*Terai*		*Eastern*		*Central*		*Western*		*Mid-Western*		*Far-Western*	
Variables		*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*
Gross revenue of production (NRs.)	Mean	20,838	22,958	11,997	15,176	14,564	16,731	31,900	33,556	28,733	31,098	19,292	18,907	19,443	21,263	17,989	26,349	10,556	14,417
	Median	13,989	14,737	7,843	12,422	10,143	11,418	24,085	23,958	21,414	20,475	13,694	13,883	12,791	12,597	10,890	20,171	4,727	10,627
	StDev.	23,133	26,254	10,514	12,020	16,180	16,140	28,899	35,278	27,792	36,958	17,468	17,179	21,692	24,766	20,215	24,956	28,203	13,462
Gross revenue of livestock (NRs.)	Mean	1,441	1,338	1,248	1,076	1,352	973	1,623	1,884	2,288	1,633	1,664	1,653	905	980	749	1,165	360	405
	Median	0	0	0	0	0	0	0	0	700	0	0	0	0	0	0	0	0	0
	StDev.	3,483	3,335	2,755	2,752	3,858	2,746	3,250	4,059	3,585	3,514	4,691	4,103	1,991	2,355	1,743	3,144	1,038	793
Labor man day	Mean	14,650	15,498	16,406	16,280	14,136	13,732	14,606	17,357	13,404	18,349	16,903	15,470	12,844	13,497	14,466	15,440	14,710	12,496
	Median	12,770	13,900	15,220	15,710	12,090	11,858	12,450	14,640	11,240	15,120	15,340	14,630	9,520	10,920	12,513	13,785	13,430	11,643
	StDev.	10,939	10,161	9,630	8,156	10,031	9,408	12,368	11,348	9,359	11,842	9,871	9,108	13,249	9,541	11,559	10,667	10,588	7,421
Cultivated area (x2)	Mean	6,675	5,240	6,812	4,348	5,114	4,106	8,531	6,969	10,848	7,889	4,151	3,756	5,247	4,782	6,937	6,064	7,503	3,224
	Median	3,988	3,893	3,367	3,988	2,645	3,191	6,548	5,114	7,123	6,370	3,008	3,008	4,158	3,457	3,539	5,309	1,770	2,526
	StDev.	10,393	5,390	11,346	2,871	11,591	3,604	7,910	7,215	15,922	7,439	3,973	3,102	5,434	5,124	8,320	4,895	14,891	2,656
Total purchase amount of fertilizer (NRs.)	Mean	744	797	283	320	287	335	1,480	1,545	650	999	919	851	948	850	496	586	113	111
	Median	181	300	42	75	60	106	915	930	180	300	406	465	181	188	0	150	0	0
	StDev.	1,741	1,600	445	465	526	614	2,574	2,288	1,303	2,342	1,947	1,161	2,211	1,440	1,308	1,414	492	234
Total purchase amount of insecticides (NRs.)	Mean	33.46	53.35	1.08	0.00	1.17	37.71	85.35	92.92	46.27	76.12	37.85	76.54	29.14	27.01	25.20	26.49	0.00	0.00
	Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	StDev.	185.85	268.50	9.30	0.00	8.43	149.20	292.90	397.83	277.01	339.47	150.05	342.89	164.57	96.88	124.70	131.57	0.00	0.00
Total purchase amount of seeds. (NRs.)	Mean	140	183	25	31	174	66	142	385	323	254	71	144	114	225	73	140	12	66
	Median	0	0	0	0	0	0	0	103	0	0	0	0	0	39	0	13	0	17
	StDev.	719	540	77	105	976	166	422	811	1,326	802	237	469	423	453	204	259	62	128
	N	503		74		236		193		127		165		114		55		42	

Note: Prices are from 1995.

We have eliminated data with Fisher index of output (Fy) less than 0.1 and more than 5, and Fisher index of input (Fq) less than 0.1 and more than 5.

Table 5 Details of Fisher index of output(Fy), input (Fq), and TFP

			Belt			*Development region*				
		Nepal	*Mountain*	*Hill*	*Terai*	*Eastern*	*Central*	*Western*	*Mid-Western*	*Far-Western*
Fy	Mean	1.45	1.64	1.51	1.31	1.23	1.34	1.33	1.88	2.37
	Median	1.16	1.47	1.21	1.00	0.945	0.992	1.18	1.74	1.90
	StDev.	1.05	1.11	1.10	0.938	0.884	1.02	0.887	1.09	1.34
Fq	Mean	1.24	1.09	1.19	1.36	1.39	1.06	1.37	1.21	1.14
	Median	1.06	1.08	0.97	1.15	1.14	0.967	1.14	1.07	0.871
	StDev.	0.834	0.617	0.801	0.930	0.908	0.626	0.930	0.809	0.951
TFP	Mean	1.70	2.03	1.97	1.25	1.10	1.67	1.44	2.34	3.52
	Median	1.05	1.37	1.13	0.963	0.823	1.16	0.992	1.51	2.75
	StDev.	2.18	2.07	2.72	1.19	0.994	2.16	1.64	3.21	3.20
log(TFP)	Mean	0.113	0.326	0.191	-0.063	0.128	-0.164	0.876	0.417	-0.027
	Median	0.044	0.315	0.120	-0.038	0.144	-0.194	1.011	0.409	-0.008
	StDev.	0.865	0.874	0.934	0.738	0.844	0.706	0.896	0.864	0.850
N		503	74	236	193	127	165	114	55	42

Source: NLSS-I and NLSS-II

Note: We have eliminated data with Fisher index of output (Fy) less than 0.1 and more than 5, and Fisher index of input (Fq) less than 0.1 and more than 5.

Table 6 Details of income sources

				Belt						*Development region*									
		Nepal		*Mountain*		*Hill*		*Terai*		*Eastern*		*Central*		*Western*		*Mid-Western*		*Far-Western*	
Variables		*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*	*1995*	*2003*
FC in 1995	Mean	5,200	6,153	4,928	5,318	5,397	6,278	5,068	6,330	5,484	6,342	5,498	5,938	5,484	7,015	4,239	5,622	3,991	4,988
	Median	4,770	5,612	4,378	4,919	4,976	5,712	4,690	5,720	5,168	6,021	5,186	5,450	4,810	6,581	3,911	4,976	3,132	4,690
	StDev.	2,397	2,577	2,558	2,037	2,570	2,820	2,085	2,402	2,043	2,262	2,479	2,586	2,529	3,022	1,862	2,243	2,619	1,775
Other income	Mean	8,388	11,309	8,487	6,492	9,070	10,475	7,519	14,226	7,147	12,958	8,693	11,750	8,045	9,516	8,977	12,013	10,621	8,975
	Median	2,723	6,786	3,600	4,780	2,880	3,140	1,585	10,239	0	7,734	2,880	6,137	3,157	4,057	5,315	7,166	5,000	7,081
	StDev.	13,606	18,272	12,042	8,839	14,479	18,198	13,095	20,544	13,501	23,105	12,314	19,477	10,846	14,283	16,897	15,575	18,685	9,720
Family members	Mean	4.44	4.52	3.81	4.30	4.16	4.10	5.04	5.13	4.85	4.76	4.46	4.54	4.29	4.30	4.27	4.57	3.94	4.36
	Median	4.21	4.36	3.57	4.21	3.93	4.07	4.66	4.71	4.50	4.75	4.29	4.36	4.16	3.88	4.05	4.41	3.50	4.07
	StDev.	1.99	2.02	1.58	1.77	1.84	1.59	2.16	2.40	2.05	1.52	1.90	2.29	1.90	2.26	1.97	1.80	2.24	1.76
Remittances	Mean	5,550	9,917	1,853	2,048	8,850	11,072	3,003	11,624	1,648	9,321	5,276	8,743	13,788	14,857	1,974	7,849	1,186	6,147
	StDev.	57,288	32,770	5,644	5,570	82,941	36,400	13,834	34,043	6,910	34,371	23,530	27,081	116,806	45,564	5,303	21,791	2,666	17,020
N		548		83		255		210		132		175		124		66		51	

Source: NLSS-I and NLSS-II

Note: All data are estimated from 1995 values.

We have eliminated data with dlt_log_Fy less than -2 and more than 2, dlt_remit less than -40,000 rupees and more than 40,000 rupees, Food95pc more than 10,000 rupees, and dlt_otherINC less than -45,000 rupees and more than 45,000 rupees.

All medians of Remittances are zero.

FC is short for food consumption per year per person.

Table 7 Details of variables in the regression

variable	*mean*	*sd*	*N*	*max*	*min*
Eq. (1)					
log(OUTPUT)	0.1149	0.7419	503	1.662	-2.007
log(INPUT)	0.0036	0.6670	503	1.588	-2.095
Eq. (2)					
log(FC in 2003/FC in 1995)	0.0449	0.5220	547	2.018	-1.877
log(Agr.GR in 2003/Agr. GR in 1995)	0.2260	0.9132	547	3.540	-2.960
DRemittances	840	48,270	547	198,966	-1,009,302
DOther income	3,042	19,714	547	191,454	-124,261
DFamily members	-0.068	2.579	547	8.0	-17.0
log(FC in 1995)	8.457	0.465	548	10.845	7.066
Food consumption (FC) in 1995	5,294	3,351	548	51,290	1,172
Percentile					
10th	2,656				
25th	3,500				
50th	4,694				
75th	6,251				
90th	8,219				

Source: NLSS-I and NLSS-II

Note: All data are estimated from 1995 values.

We have eliminated data with Fisher index of output (Fy) less than 0.1 and more than 5, and Fisher index of input (Fq) less than 0.1 and more than 5 in Eq.(1).

We have escluded data with log(Food cons. in 2003/Food cons. In 1995) less than -3.0 in Eq.(2).

Agr. GR is short for agricultural gross revenue

FC is short for food consumption

D denotes the difference between 2003 and 1995 values

Table 8 Estimates of TFP from residuals

	(1)		(2)	
	Coefficient		*Coefficient*	
log(INPUT)	0.2775	***	0.3191	***
	[0.05]		[0.05]	
Belt				
(Base group: Mountain)				
Hill			-0.0788	
			[0.10]	
Terai			-0.1779	*
			[0.10]	
Development region				
(Base group: Eastern)				
Central			0.1209	
			[0.08]	
Western			0.1135	
			[0.09]	
Mid-Western			0.4903	***
			[0.11]	
Far-Western			0.7553	***
			[0.11]	
constant	0.1139	***	0.037	
	[0.03]		[0.10]	
R-squared	0.0622		0.1654	
Adj-R-squared	0.0604		0.1536	
N	503		503	

Note: * p < 0.1, ** p < 0.05, *** p < 0.01

Values in [ ] are robust standard errors

We have eliminated data with Fisher index of output (Fy) less than 0.1 and more than 5, and Fisher index of input (Fq) less than 0.1 and more than 5.

Table 9. Relationship among food consumption, agricultural output, and other factors

	log(Food cons. in 2003/Food cons. in 1995)					
	(1)	(2)	(3)	(4)	(5)	(6)
		p10	p25	p50	p75	p90
log(Agr. GR in 2003/Agr. GR in 1995)	0.0799 ***	0.0705 ***	0.0571 ***	0.0372 **	0.00952	-0.0281
	[0.03]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
log(FC in 1995)		-0.720 ***	-0.720 ***	-0.719 ***	-0.717 ***	-0.715 ***
		[0.04]	[0.04]	[0.04]	[0.04]	[0.04]
DRemittances		2.33E-06 **	2.18E-06 **	1.96E-06 **	1.68E-06 **	1.33E-06 **
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
DOther income		8.59E-08	4.17E-07	8.85E-07	1.50E-06 *	2.27E-06 *
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
DFamily members		-0.0249 ***	-0.0249 ***	-0.0250 ***	-0.0250 ***	-0.0251 ***
		[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
(FC–pct10th)*log(Agr. GR in 2003/Agr. GR in 1995)		-1.66E-05 ***				
		[0.00]				
(FC–pct10th)*D Remittances		-1.82E-10 ***				
		[0.00]				
(FC–pct10th)*D Other income		3.93E-10				
		[0.00]				
(FC–pct25th)*log(Agr. GR in 2003/Agr. GR in 1995)			-1.69E-05 ***			
			[0.00]			
(FC–pct25th)*D Remittances			-1.82E-10 ***			
			[0.00]			
(FC–pct25th)*D Other income			3.93E-10			
			[0.00]			
(FC–pct50th)*log(Agr. GR in 2003/Agr. GR in 1995)				-1.74E-05 ***		
				[0.00]		
(FC–pct50th)*D Remittances				-1.82E-10 ***		
				[0.00]		
(FC–pct50th)*D Other income				3.93E-10		
				[0.00]		
(FC–pct75th)*log(Agr. GR in 2003/Agr. GR in 1995)					-1.80E-05 ***	
					[0.00]	
(FC–pct75th)*D Remittances					-1.82E-10 ***	
					[0.00]	
(FC–pct75th)*D Other income					3.93E-10	
					[0.00]	
(FC–pct90th)*log(Agr. GR in 2003/Agr. GR in 1995)						-1.88E-05 ***
						[0.00]
(FC–pct90th)*D Remittances						-1.81E-10 ***
						[0.00]
(FC–pct90th)*D Other income						3.92E-10
						[0.00]
Constant	0.0268	6.11 ***	6.11 ***	6.10 ***	6.08 ***	6.07 ***
	[0.02]	[0.37]	[0.37]	[0.37]	[0.37]	[0.38]
R-squared	0.0195	0.4846	0.4846	0.4846	0.4846	0.4845
Adj-R-squared	0.0177	0.4769	0.4769	0.4769	0.4769	0.4769
N	547	547	547	547	547	547

Note: * p<0.1, ** p<0.05, *** p<0.01

Robust standard errors in square brackets

We have escluded data with log(Food cons. in 2003/Food cons. In 1995) less than -3.0.

Agr. GR is short for agricultural gross revenue.

FC is short for food consumption per year per person.

(FC –pct10th/25th/50th/75th/90th) indicates the differences between food consumption in 1995 and the 10th/25th/50th/75th/90th quantile values, respectively

D denotes the difference between 2003 and 1995 values.

pct10th/25th/50th/75th/90th refers to the 10th/25th/50th/75th/90th percentiles, respectively

Table 10. Contribution of agricultural output growth to food consumption growth

		(1)		(2)	(3)	(4)
		Coefficients of agricultural output growth		Average agricultural output growth in 1995–2003	Average food consumption growth in 1995–2003	Contribution of agricultural output growth to food consumption growth =(1)*(2)/(3)
Table 9 (1)		0.0799	***			0.4631
	Percentile					
Table 9 (2)	10th	0.0705	***			0.4086
Table 9 (3)	25th	0.0571	***	0.2274	0.0392	0.3308
Table 9 (4)	50th	0.0372	**			0.2153
Table 9 (5)	75th	0.00952				0.0551
Table 9 (6)	90th	-0.0281				-0.1631

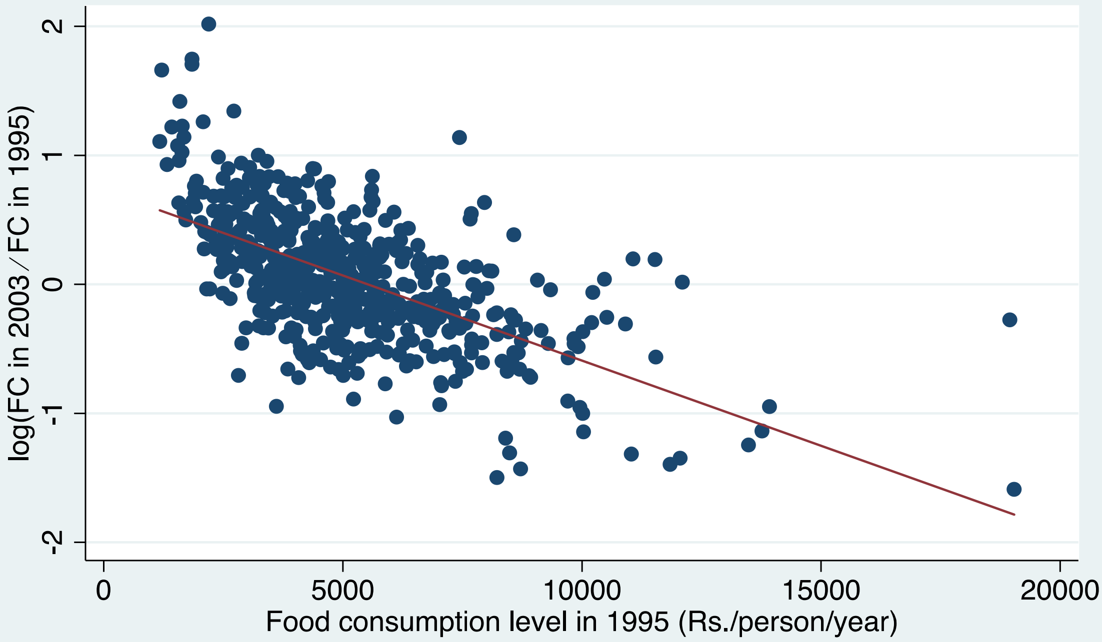
Note: * p<0.1, ** p<0.05, *** p<0.01

Values in (2) and (3) come from Table 7.

Table 11 Sum of food consumption in 1995, 2003, and 2010 (NPR)

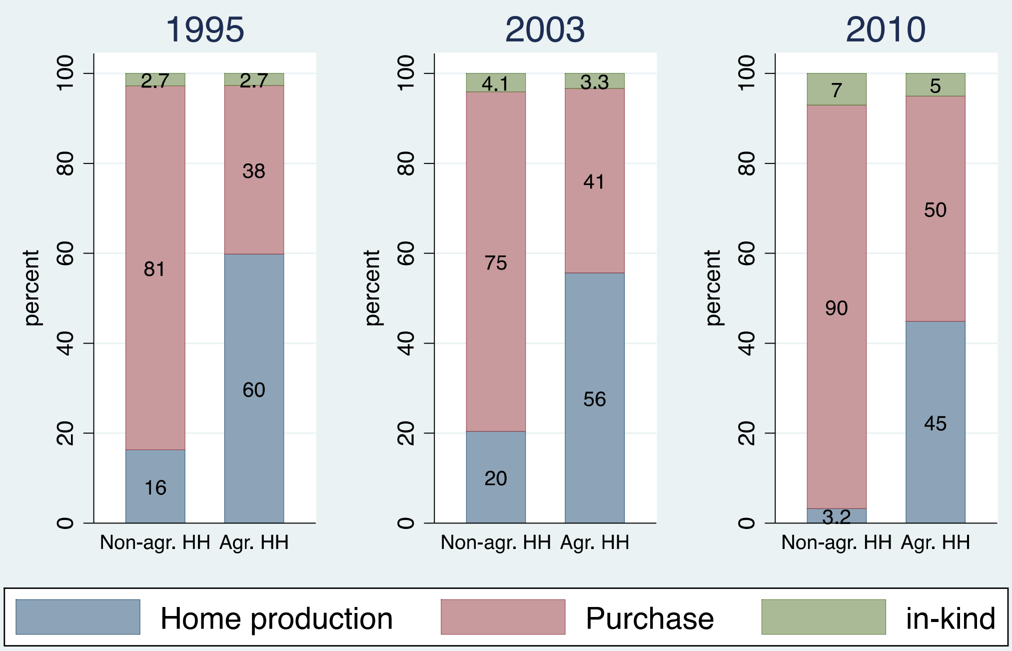
	Home production	*Purchase*	*In-kind*	*Total*
NLSS-I (1995)				
Non-agricultural household (N=153)	640,271	3,176,696	107,370	3,924,336
	(16.3)	(80.9)	(2.7)	(100.0)
Agricultural household (N=2,507)	33,010,626	20,693,927	1,470,393	55,174,946
	(59.8)	(37.5)	(2.7)	(100.0)
Total (N=2,660)	33,650,896	23,870,623	1,577,763	59,099,282
	(56.9)	(40.4)	(2.7)	(100.0)
NLSS-II (2003)				
Non-agricultural household (N=198)	985,039	3,552,633	119,605	4,657,277
	(21.2)	(76.3)	(2.6)	(100.0)
Agricultural household (N=2,828)	35,936,775	28,235,178	1,171,546	65,343,499
	(55.0)	(43.2)	(1.8)	(100.0)
Total (N=3,026)	36,921,814	31,787,810	1,291,151	70,000,776
	(52.7)	(45.4)	(1.8)	(100.0)
NLSS-III (2010)				
Non-agricultural household (N=1,859)	1,624,837	41,400,368	1,649,450	44,674,655
	(3.6)	(92.7)	(3.7)	(100.0)
Agricultural household (N=3,971)	46,266,050	52,715,638	2,174,149	101,155,837
	(45.7)	(52.1)	(2.1)	(100.0)
Total (N=5,830)	47,890,887	94,116,006	3,823,599	145,830,492
	(32.8)	(64.5)	(2.6)	(100.0)

Source: NLSS-I, NLSS-II, and NLSS-III
Note: Prices are from 1995.
We have eliminated data with food consumption per year per person (nutrient) of less than 1,000 rupees and more than 20,000 rupees.



Note:FC means food consumption in rupees per person per year
Food consumption level in 1995 is less than 20,000(Rs./person/year)

Figure 1
Growth of food consumption vs. food consumption level in 1995



Source: Nepal Living Standard Survey-I, -II and -III

Figure 2 Food expenses and home production