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**RESEARCH PAPER**

# Role of HDI For the Effect of Urbanisation on Food Security: The Case of Asian Developing Economies

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**ABSTRACT**

Food Insecurity is a global issue which is having many determinants including urbanisation. The present study examines the impact of urbanisation on food security through the human development of Asian developing economies. For this purpose, the data of selected Asian developing economies is collected from 1990 to 2016. The panel estimation technique, Generalised Method of Moments (GMM) is applied to analyse the relationship between urbanisation and food security along with some other control variables. Food security is measured through its indicators given by the Food and Agriculture Organisation (FAO) which includes Average dietary energy supply adequacy (Availability), Prevalence of undernourishment (Access), access to improved water resources (Utilisation) and food imports over total merchandise exports (Stability) have been used as food security indicators. The results support the view that urbanisation holds both opportunities and challenges for a country's development level, which in turn affects food security. The results also claimed that Trade and Foreign Direct Investment have a mixed relationship with food security indicators. The number of disasters increases while Good Governance decreases food insecurity, respectively.

## Introduction

Food insecurity has both short and long-term impacts on human survival and well-being. According to the Food and Agriculture Organisation FAO, (2001), food insecurity exists when people lack of physical, social or economic access to safe and healthy food. With time, food consumption is increasing, but many people live below the poverty level Szabo, (2016).

The phenomenon of rapid urbanisation across the globe has become a theme of increased scholarly analysis. The linkage between population and food are well known. Urbanisation is defined as the increase in population resident in urban areas (cities and towns) rather than rural areas. The number of megacities having a population of ten million increased from 1995-2007 more than six times from 3 to 19 cities worldwide. Small to medium cities have fewer necessities of life; this leads to the creation of slum areas having low income, over crowdedness and living a life in poor conditions Matuschke, (2009).

In many developing economies, rapid urbanization is result of poor planning and management of human settlements and physical environment are at greatest risk of food insecurity Szabo, (2016). Urbanisation affects all four dimensions of food security, i.e., Availability, Access, Stability and Utilisation Matuschke, (2009). The primary reason for the shortage of food is that the rate of population is increasing is greater than the speed of food production Malthus, (1798). Urbanisation also holds both opportunities and challenges for human development. In addition to that, food security and human development are also linked in a complex manner, and one cannot be achieved without improving the other Conceição *et al.,*(2011). Economies with the lowest levels of human development likely to be associated with greater food insecurity risks.

The main objective of the study is to examine the impact of urbanization on food security and also to explore the role of human development in the association between urbanization and food security in selected developing economies using panel data for selected developing economies over the period of 1990 to 2016.We carry out GMM estimation technique for this purpose. The selected Asian developing economies are: Afghanistan, Armenia, Azerbaijan, Bangladesh, Cambodia, India, Indonesia, Iran, Iraq, Jordon, Kazakhstan, Kyrgyz Republic, Lao PDR, Lebanon, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Tajikistan, Thailand, Timor Leste, Turkey, Vietnam and Yemen.

To the best of our knowledge, no such study has been made at regional level. Furthermore, the study examines the four dimensions of security i.e., Availability, Access, Stability and Utilization one by one and analyses the relation with the explanatory variables. The interaction term (RUG*LD) is another addition to this study.

**Literature Review**

This section reviews the concept of food security and its relationships between urbanisation and human development. Explanatory variables are Rate of Urbanisation, Level of Development, Total Fertility Rate, Trade Openness, Foreign Direct Investment, Agriculture Land, Number of Disasters and Rule of Law and interaction term (RUG*LD). With the help of the given evidence, the potential gap related to our topic is examined.

Scalan, (2001) observed Neo Malthusian and technological determinants of food security. He examined the relationship in lesser-industrialised societies between 1970 and 1990. He used dietary energy supply to measure food availability, and for food access, he took lagged values of the percentage of children who were not undernourished and applied OLS regression. The results confirmed that population pressure and urbanisation affect food availability and food access negatively.

Jenkins and Scalan, (2001) examined the relation between FDI and food security. They measured food security through daily calorie and protein intake per capita and FDI as stock over total capital stock ratio. They investigated the effects on 88 developing countries throughout 1970-1990. The results confirmed that FDI affects food security negatively.

Bandara and Cai, (2014) studied the changing in food productivity via the yield of the crops including wheat, rice and cereal grains on food prices and food security due to climate change in selected South Asian countries including Pakistan. De Muro and Burchi, (2007) used data from the demographic and health survey at the household level for 48 low-income countries from 1995 to 2004. Indicators for food insecurity were infant and child mortality rate, wasting, stunting, underweight and female malnourishment. Using multiple regression analysis, it was confirmed that education was negatively related to food insecurity.

Slimane *et al.,* (2016) analysed the effect of FDI on food security along with other explanatory variables. They collected the data of 55 developing countries from 1995 to 2009 and used the 3SLS technique to determine the relationship. They developed a composite indicator to measure food availability and food utilisation. They found that sectoral FDI in the agricultural sector increased food security while FDI in the tertiary sector decreased food security. They also found that FDI spill overs through agricultural production to food security.

Manap*et al.,* (2015) used proxy for measuring food insecurity i.e., food inadequacy, prevalence of undernourishment and depth of food deficit. They collected the data of selected developing countries for 1990-2017. The research suggested that an increase in food productions and imports were positively related to improved food insecurity.

Chatterjee *et al.,* (2012) also gave empirical evidence on the impact of household income and other socioeconomic on food insecurity in an urban poor household in Mumbai, India. Food insecurity was measured by household food insecurity access scale. A questionnaire survey of 283 households was conducted after bivariate and multivariate analysis.

Long *et al.,* (2018) examined the relationship between per capita construction land transition and per capita farmland transition and their impact on food security in a farming area of China. They collected the data throughout 2000-2015 and used

spatial econometric regression analysis. The results showed that construction land increased while farmland reduced.

Cheema and Abbas, (2016) analysed the factors of food insecurity by using Pakistan Social and Living Standard Measurement survey data 2010-2011 of Pakistan. Sample size was 16431. Food insecurity was measured through the food security index. The results after applying binary logistic regression revealed that food insecurity is negatively related to education, livestock, foreign remittances and female family heads, whereas it is positively related to poverty in Pakistan.

Bashir *et al.,* (2012) used both primary and secondary data. Secondary data was collected from FAO, while for primary data, they interviewed using a questionnaire survey of 1152 households in 12 districts of Punjab province. The food security status of households was calculated through the calorie intake method. They used logistic regression. The results revealed that food security at a national level is high in Pakistan, while food insecurity exists at the household level. Education was positively related to food security, while the family size was negatively related to it.

Chang and Sumner, (2004) argue that the opening of trade increased the food security of rural farm households in China. They gathered data of grain market price from 1991 to 2000, along with survey data of households collected in 2000. They applied the technique of OLS, and the lowers smoothing method.

**Material and Methods**

This study comprises a panel data set of 28 developing Asian countries from 1990-2016. The countries and the selection of variables are elected on the accessibility of data.

**Econometric Specification**

The indicators are chosen on the availability of data on these four models. The first model represents the Food Availability measured by Average Dietary Energy Supply Adequacy (ADESA). The second model is about Food Access and is calculated by prevalence of undernourishment (PoU). Food Utilisation is measured in third model with the help of Access of Improved Water sources (AIWS). The last model shows Food Stability measured by the Value of Food Imports over total merchandise exports (VFITME).

The econometric specification of the above models are as follows,

**Model 1 (Food Availability)**

$$lnADESA_{it} = \alpha_o - \alpha_1 lnRUG_{it} + \alpha_2 LD_{it} + \alpha_3 RUG * LD_{it} + \alpha_4 lnTFR_{it} + \alpha_5 lnTO_{it} + \alpha_6 lnFDI_{it} + \alpha_7 lnAGRL_{it} + \alpha_8 lnND_{it} + \alpha_9 RL_{it} + \mu_{it} \text{(i)}$$

**Model 2 (Food Access)**

$$lnPoU_{it} = \beta_o + \beta_1 lnRUG_{it} + \beta_2 LD_{it} + \beta_3 RUG * LD_{it} + \beta_4 lnTFR_{it} + \beta_5 lnTO_{it} + \beta_6 lnFDI_{it} + \beta_7 lnAGRL_{it} + \beta_8 lnND_{it} + \beta_9 RL_{it} + \mu_{it} \quad \text{(ii)}$$

**Model 3 (Food Utilisation)**

$$lnAISW_{it} = \delta_o + \gamma_1 lnRUG_{it} + \gamma_2 LD_{it} + \gamma_3 RUG * LD_{it} + \gamma_4 lnTFR_{it} + \gamma_5 lnTO_{it} + \gamma_6 lnFDI_{it} + \gamma_7 lnAGRL_{it} + \gamma_8 lnND_{it} + \gamma_9 RL_{it} + \mu_{it} \text{(iii)}$$

**Model 4 (Food Stability)**

$$lnVFITME_{it} = \delta_0 + \delta_1 lnRUG_{it} + \delta_2 LD_{it} + \delta_3 RUG * LD_{it} + \delta_4 lnTFR_{it} + \delta_5 lnTO_{it} + \delta_6 lnFDI_{it} + \delta_7 lnAGRL_{it} + \delta_8 lnND_{it} + \delta_9 RL_{it} + \mu_{it} \quad \text{(iv)}$$

Notations used in the above equations are defined as follows,

*ADESA*= Average Dietary Energy Supply Adequacy, *PoU*= Prevalence of Undernourishment, *AIWS*=Access to Improved Water Sources, *VFITME*=Value of Food Imports over Total Merchandise Exports, *RUG*=Rate of Urban Growth, *LD*=Level of Development, *TFR*=Total Fertility Rate, *TO*=Trade Openness, *FDI*=Foreign Direct Investment, *AGRL*=Agricultural Land, *ND*=Number of Disasters, *RL*=Rule of Law and *RUG*LD*= The interaction between rate of urban growth (RUG) and level of development (LD).

**Sources of Data**

Data of *dependent variables* **(**Average Dietary Energy Supply Adequacy, Prevalence of Undernourishment, Access to Improved Water Sources and Value of Food Imports over Total Merchandise Exports) is collected from **Food and Agriculture Organization (FAO).** While data of independent variables (Interaction Term, Rate of Urban Growth, foreign Direct Investment, Total Fertility Rate, Trade openness and Agricultural Land) is collected from **World Wide Development Indicators (WDI).** On the other hand, data of variables like Level of Development, Number of Disasters and Rule of law is collected from **Human Development Report (HDR), Disaster Database (EM-DAT)** and **Worldwide Governance Indicators (WGI)** respectively.

**Estimation Methodology**

The present study uses a data set of 28selected Asian developing countries from 1990 to 2016. Four models represent the link between each dimension of food security: urbanisation, human development, and other factors. For this purpose, panel estimation technique is required for above mentioned four models. we apply different estimation techniques,i.e., pooled OLS, fixed and random effects, and in the end, we select Difference GMM based on the above tests in all models. Pooled OLS

estimation is rejected because of heterogeneity in all models. This is done with the help of Breusch &Pegan (B&P) Lagragian test. After the fixed and random effects estimation, the Hausman test is used to detect which model is appropriate, whether fixed or random. Hence, in our case, the Hausman test suggests a fixed effect model is suitable as the p value is less than 0.05 in all models.

Heteroscedasticity is checked with the help of the Modified Wald test. The result indicates the presence of group-wise heteroscedasticity in all models as the p value is less than 0.05 which rejects the null hypothesis. Hence, there is no heteroscedasticity. Then we move towards the Wooldridge test to detect autocorrelation in all models. The p-value is less than 0.05, which indicates the presence of autocorrelation in each model, which clearly shows the rejection of the null hypothesis. This shows that there is no first-order autocorrelation. After crossing through various tests, we selected Difference GMM on the basis of suitable diagnostic tests because above mentioned all econometric problems like heteroscedasticity, endogeneity and serial autocorrelation make model a dynamic panel model.

Regression results of model 1 (Availability), model 2 (Access), model 3 (Stability) and model 4 (Utilisation) will be discussed in this section one by one. The results of model 1 are regressed by using Difference GMM and are as follows.

**Table 1**
**Results of Difference GMM (Dynamic Panel Data Specification)**

| Variables | Model 1<br>lnADESA | Model 2<br>lnPoU | Model 3<br>lnAIWS | Model 4<br>lnVFITME |
|---|---|---|---|---|
| | .5695118<br>(.14383) | .7756068<br>(0.048) | .9626529<br>(0.007) | .7772435<br>(0.107) |
| **lnRUG** | .0188569***<br>(0.007) | -.125199*<br>(0.068) | -.0016069<br>(0.0022) | .2896303<br>(0.1824) |
| **LD** | .5750067***<br>(.1781) | -1.411396***<br>(0.526) | .010902<br>(0.007) | 4.16762***<br>(1.131) |
| **RUG*LD** | -.0164432***<br>(.0063) | .1140043**<br>(.8198) | .0015576<br>(.0019) | -.2485501**<br>(.12382) |
| **lnTFR** | .0969793***<br>(0.0217) | -.0761596<br>(0.166) | .0010849<br>(0.0088) | 1.329714***<br>(0.332) |
| **lnTO** | -.0006968**<br>(0.00029) | .0066832<br>(0.0102) | …… | …… |
| **lnFDI** | -.0002497<br>(0.0005) | -.0069058***<br>(0.000) | .0000694<br>(0.000) | .013453**<br>(0.006) |
| **lnAGRL** | -.1118895*<br>(0.0675) | -.0278914<br>(0.027) | .002696***<br>(0.001) | -.5887254<br>(0.431) |
| **lnND** | -.000414<br>(0.0004) | .0027208<br>(0.001) | -.0002004***<br>(0.000) | .0160334**<br>(0.007) |
| **RL** | .0205423***<br>(0.0055) | -.0400238***<br>(0.016) | -.0024419***<br>(0.000) | …… |
| **Sargan Test** | 326.0742<br>(0.000) | 619.0078<br>(0.000) | 316.3889<br>(0.000) | 272.178<br>(0.000) |

| | | | | |
|---|---|---|---|---|
| **AR(1)** | 1.905<br>(0.0508) | 2.3396<br>(0.0193) | -3.2865<br>(0.0010) | -2.4719<br>(0.0134) |
| **AR(2)** | -.88991<br>(0.3735) | .2338<br>(0.8151) | 0.41711<br>(0.6766) | 0.75019<br>(0.4531) |

Note: (1) The parentheses show standard error. ***, **, * are representing 1%, 5%, 10% level of significance respectively. (2) The first order and second order serial correlation are presented by AR (1) and AR (2) respectively having p-values in parentheses. (3) Sargan test of the over-identifying restrictions of each model with p-values in parentheses.

**Results and Discussion**

First, Arellano bond estimation with one step is performed then for the validity of over identifying restrictions, a test called Sargan test is applied in every model. The results revealed that p value is less than 0.05, which rejects the null hypothesis of over-identifying restrictions. Then we move towards Arellano Bond estimation with two-step estimators. The results are significant. Furthermore, the Arellano Bond test is used for autocorrelation, which is removed at order 2.

The interpretation of each variable in all models is as follows,

**Impact of Rate of Urban Growth on food security**

M**odel 1** shows the relation between the average dietary energy supply adequacy and the rate of urban growth is positive and significant. A 1% increase in the urban growth rate will increase the average dietary energy supply adequacy by 0.1885%. The average nutritional energy supply has improved due to the rise in food trade and improved food production technologies. These results are consistent with the study of Lazarids andFousekis, (2005).

M**odel 2** show a negative and significant relationship between the prevalence of undernourishment and urban growth rate. The results imply that 1% increase in of urban growth rate decreases the prevalence of undernourishment by 0.125%. This result is consistent with the result of Smith et al.,(2005).

**The results from model 3**show that the relationship between access to water resources and urban growth rate is negative and insignificant. The result is interpreted as a 1% increase in the rate of urban growth that decreases access to improved water resources by 0.0016%. The negative relationship is consistent with the study of Fodgenand Wood, (2007).

**Model 4 shows** a positive but insignificant relationship between the food imports over total merchandise exports and urban growth rate. An increase in the 1% urban growth rate increases food imports over total merchandise exports by 0.289%. Increased urbanisation boosts the food imports Rakotoarisoaet al., (2011).

**Impact of Level of Development on Food Security**

**In model 1**, there is a positive and significant relationship between average dietary energy supply adequacy and level of development. The result is interpreted as 1% increase in the level of development increases the average dietary energy supply adequacy by 0.575%. Many developed countries have a higher average nutritional energy supply as compare to developing countries. Furthermore, the developed countries are near or even exceeding their average dietary energy supply kcal/person/day. This is consistent with the study of Lazarids and Fousekis, (2005).

**In model 2**, there is a negative and significant relation between the prevalence of undernourishment and level of development. The regression coefficient value shows that 1% percent in level of development decreases the prevalence of undernourishment by 1.4113%. A low level of undernourishment is linked with a high level of education, one of the HDI indicators. Countries with better physical and financial access to food have a low level of undernourishment. The findings are justified by [De Muro and Burchi, (2007); Szabo (2016); Gani and Prasad (2007); Smith etal., (2017); Conceiçãoetal., (2011)].

**In model 3**, there is a positive but insignificant relationship between access to improved water sources and level of development. 1% increase in development level increases the key to improve water resources by 0.10902% in model 3. Developed countries have higher access to improved water sources as compare to developing countries UNICEF, (2009).

**In model 4**, there is a positive and significant relationship between the value of food imports over total merchandise exports and level of development. 1% increases in the level of development increase the value of food imports over total merchandise exports by 4.1676%. This is similar to the theory that even high HDI value countries (e.g., MENA region (Middle East and North Africa) import high amounts of food due to resource constraints. They can pay their import bills through merchandise exports Capone, et al., (2014).

**Impact of Interaction Term (RUG*LD) on Food Security**

**In model 1**,the relationship between the average dietary energy and the interaction term (RUG*LD) is negative and significant. The result is interpreted as if the rate of urban growth in a country with a low level of development increases by 1% The average dietary energy supply decreases by 0.0164%. The result is consistent with the study of Scalan. 2001; Szabo (2016).

**Model 2** accounts for the relationship between the prevalence of undernourishment and interaction term (RUG*LD). The results show a positive and significant effect, which is interpreted as a 1% increase in urban growth rate in a country of low development increases the prevalence of undernourishment by 0.1140%. They are unable to complete their food requirements, and hence food insecurityincreases. The result is matched with the findings of De Muro andBurchi

(2007); Szabo (2016); Ganiand Prasad (2007); Smith et al., (2017); Conceiçãoet al., (2011).

While**in model 3**, access to improved water sources and interaction term has a positive but insignificant relation. The result is interpreted as one percent increase in the rate of urban growth in a country of high development, increasing access to improved water sources by 0.0015%. The result is consistent with the study of UNICEF (2009); WHO (2015).

**In model 4**, there is a negative and significant relationship between the value of food imports over total merchandise exports and the interaction term. The results from model 4 show that a one percent increase in the urban growth rate of a high HDI country decreases the food imports over total merchandise exports. The result is consistent with the study of Capone, et al., (2014).

**Impact of Total Fertility Rate on Food Security**

**In model 1**, the average dietary energy supply and total fertility rate have positive and significant relation, which means that 1% increase in total fertility rate will increase the average dietary energy supply adequacy by 0.0969%. The dietary energy supply is increased with the population. With the help of domestic food production and food trade, dietary energy supply is growing with the population. This is consistent with the study of Porkkaetal., (2013).

**In model 2**, there is a negative but insignificant relationship between the prevalence of undernourishment and the total fertility rate. The result of model 2 indicates that 1% increase in the total fertility rate decreases the prevalence of undernourishment by 0.0761%. Developing countries also show a decrease in the prevalence of undernourishment but at slow pace. The decline in the prevalence of undernourishment a is due to stable economic growth, the presence of resources for food production, good infrastructure, internal peace and institutional stability. This is justified by the studies of FAO, c (2015); Satterthwaite et al., (2010).

**In model 3**, the relationship between access to improved water sources and total fertility rate is positive but insignificant. The result is interpreted as 1% increase in total fertility rate, increases the access to improved water sources by 0.001%. In developed countries, for example, in East Asia and Pacific majority of the population uses improved drinking source UNICEF, (2009)

**In model 4**, there is a positive and significant relationship between value of food imports over total merchandise exports and total fertility rate. The result is interpreted as 1% increase in total fertility rate increases the value of food imports over total merchandise exports by 1.3297%. Domestic production cannot feed the growing population due to scarce resources like land and water, etc. Developing countries have higher food imports over total merchandise exports. They spent a large amount of exports revenue to pay import bills Rakotoarisoa et al., (2011).

**Impact of Trade Openness on Food Security**

**In model 1**, trade openness has a negative and significant effect on average dietary energy supply adequacy. The result is interpreted as 1% increase in trade openness will decrease the average dietary energy supply adequacy by .0006968 %. This goes with a study of (FAO a 2015), which says that trade reduces the availability of domestic crops in exporting countries.

**In model 2**, there is a positive but insignificant relation between the prevalence of undernourishment and trade openness. The results interpret as 1% increase in trade openness, increases the prevalence of undernourishment by 0.0066%. For net-exporting countries, the availability of domestic food declines as the food is exported. Moreover, consumer prices increase more in urban than rural areas due to limited trade reforms, which further affect the accessibility to food. This makes the poor vulnerable to undernourishment. The result is consistent with findings of FAO c (2016); Hawkes (2007).

**Impact of Foreign Direct Investment on Food Security**

**In model 1**, the relation between average dietary energy supply adequacy and Foreign Direct Investment (FDI) is negative but insignificant, which means that a 1% increase in FDI decreases average nutritional energy supply by 0.00024%. According to the dependency theory, once foreign investors introduce advanced technology, they overcome local firms. The productivity of local farms decreases. The foreign investors snatch the local lands and do not pay the desired revenue to the locals. The negative result between the variables is matched with the studies of Wimberley (1991), Wimberley and Bello (1992), Jenkins and Scalan (2001), Mihalacheand Li (2011).

**In model 2**, the value of the regression coefficient suggests that a 1% increase in FDI decreases the prevalence of undernourishment by 0.0069%. There is a significant relationship between them. FDI in the agricultural sector can enhance people's nutritional status as they get more and improve food. It also increases the income of the farmers, which enhances their accessibility. On the other hand, FDI in the secondary sector also enhances food security by increasing employment rate and wages, improving their undernourishment. The result is supported by Timmer (2010), Jenkins and Scanlan (2001).

**In model 3**, a positive and insignificant relationship between access to improve water resources and FDI.A 1% increase in FDI increases access to water resources by 0.00069%. The result is similar to the studies of Koohafkan et al., (2011); Hutton, and WHO, (2012).

**In model 4**, the relationship between food import value over total merchandise exports and FDI is positive and significant. It can be interpreted as a 1% increase in FDI leads to a rise in food imports by 0.0134%. The theory behind this is

that FDI may increase the imports of the host economy by growing demand for foreign inputs (Slimane, et al., (2016).

**Impact of Agricultural Land on Food Security**

**In model 1**, there is a negative and significant impact of agricultural land on average dietary energy supply adequacy. The above estimation result interprets as 1% increases in agricultural land decrease the average dietary energy supply adequacy by 0.1118%. This negative relationship shows that agricultural lands are used for commercial and residential purposes due to increasing urbanisation rather than agricultural purposes Adom, (2014).

**In model 2,**a 1% increase in agricultural land decreases the prevalence of undernourishment by 0.0278% in model 2. The negative relationship between the two variables can be justified by the theory that increases in agricultural land increase food production, further decreasing undernourishment. The idea is justified by the study of FAO c (2015).

**In model 3**, the positive and significant relationship between access to improved water sources and agricultural land. The result shows that a one percent increase in agricultural land increases the access to improved water sources by 0.0026%, which is justified by the theory that using of more land areas creates jobs and boosts the income of the people which make them accessible for improved water sources (Mahama, et al., 2014)

**In model 4**, there is a negative and insignificant relationship between the value of food imports over total merchandise exports and agricultural land in model 4. The result is interpreted as one percent increase in agricultural land decreases the value of food imports over total merchandise exports by 0.5887%. The negative sign is supported by the theory that when land areas are appropriately used for food production, domestic production is good enough to meet food demand. It can decrease food imports Rakotoarisoa et al., (2011).

**Impact of Number of Disasters on Food Security**

**In model 1**, there is a negative and insignificant relation between average dietary energy supply adequacy and the number of disasters. The interpretation of the result is that 1% increases in disasters decrease the average dietary energy supply adequacy by 0.00041%. The negative sign between the variables is similar to the findings of FAO b, (2015), FAO e, (2016).

**In model 2**, the prevalence of undernourishment has positive and insignificant relation with the number of disasters. The result is interpreted as a 1% increase in the number of disasters, increasing the prevalence of undernourishment by 0.0027%. Disaster damages the crops, infrastructure and increases the food prices,

which hurts the accessibility of food and increases the undernourishment among people. The results are consistent with the studies of FAO e, (2016); FAO b, (2015).

**In model 3,** the value of the regression coefficient between the number of disasters and access to improve water sources is negative and significant. The result is interpreted as a 1% increase in the number of disasters, decreasing access to improve water sources by 0.0002%. The result is similar to the study of Pahoet al., (2006).

**In model 4**, it can be seen from the result that there is a positive and significant relation between the value of food imports over total merchandise exports and the number of disasters. The result is interpreted as a 1% increase in the number of disasters, increasing the value of food imports over total merchandise exports by 0.0160%. Disasters such as floods, cyclones, and drought increase food imports as they destroy the crops Rakotoarisoa et al., (2011).

**Impact of Rule of Law on Food Security**

**In model 1**, the relation of average dietary energy supply and the rule of law is positive and significant. One percent increase in the rule of law increases the average dietary energy supply adequacy by 0.020%. The results are supported by the theory that the strong role of rule of law ensures that the food is available to everyone, eliminates the corruption and minimise the gender as well as social inequalities, and provides food safety nets to those who cannot afford food. The result is matched with FAO's studies (2011); USAID (2013).

**In model 2**, the relation between the prevalence of undernourishment and the rule of law is negative and significant. One percent increase in the rule of law decreases the prevalence of undernourishment by 0.0400% FAO, (2011) support the result; USAID (2013) says that a good government stabilises the price and improves infrastructure, which are the critical elements of food access.

**In model 3**, the result is interpreted as a 1% increase in the rule of law, decreasing access to improve water sources by 0.0024%. The negative and significant relation betweenaccesses to improves water resources and rules of law. This can be justified by the theory that in many developing countries, the judicial system and law enforcement systems are inadequate, due to which water resource management is weak Batchelor, (2007).

Furthermore, Sargan test values of model 1, 2, 3 and 4 are 0.000, which is less than 0.05. It means that over-identifying restrictions are valid, rejecting the null hypothesis. Thus, this test shows that in the Arellano bond with one step estimator, the over identifying restrictions are invalid, indicating moving towards Arellano Bond with two-step estimators.

After applying the Arellano Bond with two-step estimators, the very next step is to remove the autocorrelation problem. The p-value at order 1 is less than

0.05, indicating the presence of autocorrelation. So, we reject the null hypothesis, which states that there is no autocorrelation. Whereas at order 2, the p-value is greater than 0.05, so we accept the null hypothesis. Hence, autocorrelation in removed at AR(2). In the end, the estimates are consistent and unbiased after applying the two-step Arellano Bond dynamic panel data.

## Conclusion

This study concludes that, all variables have an important role in determining the food security but different variables have different relation with food security indicator. Rate of urban growth has positive relation with average dietary energy supply adequacy (food availability) and value of food imports over total merchandise exports (food Stability) and negatively related to prevalence of undernourishment (food access), and access to improved water sources (food utilization). Level of development has positive relation with average dietary energy supply adequacy, value of food imports over total merchandise exports and access to improved water sources but negatively related to prevalence of undernourishment. Total fertility rate has positive and significant relation with average dietary energy supply, value of food imports over total merchandise exports and access to improved water sources. While it has negative relation with prevalence of undernourishment. Trade openness has negative and significant relation with average dietary energy supply adequacy but positively related to prevalence of undernourishment. FDI has negative relation with average dietary energy supply adequacy and prevalence of undernourishment and has positive relation with access to improved water sources and value of food imports over total merchandise exports Number of disasters has negative relation with average dietary energy supply adequacy and access to improved water sources. While it has positive relation with Value of food imports over total merchandise exports and prevalence of undernourishment. Agricultural land has significant and negative relation with average dietary energy supply adequacy, prevalence of undernourishment and value of food imports over total merchandize exports. While it has positive relation with access to improved water sources and. Rule of law has positive and significant relation with average dietary energy supply adequacy and has negative as well as significant relation with access to improved water sources. It has negative relation with prevalence of undernourishment. The interaction term i.e., RUG*LD has negative relation with average dietary energy supply adequacy and value of food imports over total merchandise exports and positive relation with prevalence of undernourishment and access to improved water sources.

## Policy Recommendations

The results of the study recommend that,

- Developing Asian economies like Pakistan should make strategies and policies to distribute the benefits of urbanisation equitably and sustainably.

- Governments should increase investment and innovation in the agriculture sector to promote young farmers. The governments should promote sustainable investments to produce more food per unit of land, water, and human resources without hurting the environment.

- Developing economies in Asia should expand access to improved water sources, sanitation facilities, and health care, which are important for improved nutrition outcomes. Ministries that manage the investments for this purpose require multi-sectoral coordination.

- Asia is a disaster-prone region which happens. Farmer's risks and uncertainties related to weather, fluctuations in market systems and natural disasters should be reduced. There should be effective policies and plan of action for disaster reduction and management for quick recovery mechanisms to ensure post-disaster rehabilitation of people and the farming system.

- It might be beneficial for national policymakers of countries with food insecurity to make FDI policies on food security. They must keep in mind that FDI does not harm national food security. Foreign investors should be informed that their investment must not harm national food security and if it does, they are liable for it.

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