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FORECASTING OF AGRICULTURAL EXPORT EARNINGS OF BANGLADESH: AN EMPIRICAL STUDY OF FRESH VEGETABLES AND FRUITS MARKETS

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ABSTRACT

The study fitted ARIMA models based on some diagnostic tests and ARIMA (1, 1, 8) was finally chosen for total export, ARIMA (6, 2, 6) for agricultural export and ARIMA (1, 2, 1) for vegetables exports and ARIMA (8, 2, 8) for fruits export earnings. The percent of export earning was 10% in 2006-07 which would gradually increase up to 2008-09 and it would remain same till 2010-11. If the existing agricultural export earnings continue, Bangladesh would obtain 13% higher growth in the year 2006-07 but 6% lower growth in the year 201011 than the preceding years, respectively. The vegetables export earnings in Bangladesh would mark 23% growth in 2006-07 but it would decrease by 10% in of 2010-11. So, the government of Bangladesh should take cash incentive export policy for the development of this sector. It is strongly recommended that forecasting of the export earnings might be implemented in export policy making, especially in planning and development in Bangladesh, because these were cost effective and more accurate.

I. INTRODUCTION

A large number of agricultural products are being grown in Bangladesh. The Government of Bangladesh has taken highly ambitious steps of expanding all possible facilities and opportunities related to the export of agricultural products. The government and the exporters are working together to set up "export village" for production of quality vegetables and fruits in the country. Among the agricultural products, various types of fresh vegetables are being regularly exported from Bangladesh to about 35 countries of the world (Quasem, 2003). Bangladesh has achieved a remarkable progress in exporting agricultural products. Vegetable export contributed 1.69% to the agricultural export in 1973-74 and it increased up to 86.98 % by1996-97.This share, however, decreased in the recent years and it stood at 44.52% in 2005-06.The contribution of and fruits and vegetables to agricultural export increased from 198081 to 2005-06 due to having impact of export trade liberalization in Bangladesh (EPB, 2004).

Bangladesh enjoys a comparative advantage in fruits and vegetables production, thereby having the potential to export significant quantities of fresh fruits and vegetables to international markets at competitive price (Ateng, 1998; 1998; Mahmud *et al.*, 2000). The

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country is in a particularly good position to supply high-value fruits and vegetables to markets in Europe and the Middle East during the winter months. About 45 items of fresh fruits and vegetables are being exported to the UK, Middle East, Germany, Italy, New York, and Amsterdam. The quantity of vegetables export was highly dependent on the production of fruits and vegetables (Saha, 2000). The total quantity of fruits and vegetables exported was around 11000 tonnes at Tk.20 million in foreign exchange. The export to UK accounted for 100.25 tonnes while in the Middle East it was 100.25 tonnes per week (Ullah, 1995). The export of all horticulture to total country's export share is below 0.5% and thus, all policy makers may not take equal interest in expanding horticultural exports. But it may be noted that the demand for fruits and vegetables is steadily rising at home and abroad as their consummations are income elastic and the affluent people in the developed countries prefer fruits and vegetables to high cholesterol foods (Hommna, 1991) because of health consciousness. Bangladesh should thus, take advantage of export potentials in horticultural crops (Quasem, 2003). Bangladesh could have earned Tk.4000 million in foreign exchange by exporting fruits and vegetables each year (Kamaly, 1995). Hoq (2006) estimated 75.43% in the year of 2003-04 to 2004-05 as annual change of export earnings from fruits and vegetables. Therefore, Bangladesh has immense prospects for earning foreign currency by exporting vegetables to the world markets. So far, the development of fruits and fruits and vegetables export, the government has under taken some decision such as (i) to establish some "Export villages" in and around certain selected fruits and vegetable growing;(ii) to explore markets in the countries of Western Europe, Middle East, Singapore and Japan for export of fresh vegetables; (iii) to increase cargo space capacities for carrying fresh vegetables, especially by the Biman Bangladesh Airlines and other airways;(iv) to ensure availability of international standard packaging materials and its use for the interest of maintaining quality of fresh vegetables; (vi) for charging airfreight at lower rate for exports of all vegetables including fruits and all other commodities; (vii) withdrawal of royalty from foreign airlines extending cargo services;

Sunanwadee (1989) conducted a study on "Thailand's export development of fresh vegetables and fruits'. The study emphasized on the existing majors markets of fresh fruits and vegetables such as, Hong Kong, Malaysia and Singapore and new potential markets, viz., Japan, France and the United Kingdom(UK).The variance and correlation analysis were applied in this study. He was not mentioned any deterministic model for forecasting. Mayer *et al.* (1991) conducted a study on "Modeling export opportunities for the Hong Kong fresh vegetables and fruits markets. The study describes a method of quantifying the economic feasibility of export schemes to supply this market. A simple regression model of semi logarithmic form was fitted for determining the effect of exported quantity of fresh fruits and vegetables on price. Kamaly (1995) conducted a study on "Exporting fruits and vegetables: problems and solutions. The study identified some problems such as, packaging materials, High interest rate of credit; inferior quality of products; no export village to give loans on soft term basis; poor support to Bangladesh trade mission abroad ; and Air cargo space allocation, absence of local and international cargo and high royalty imposed by the civil aviation authority than other airlines.

ARIMA types were very powerful and popular as they can successfully describe the observed data and can make forecast. with minimum forecast error (Haque *et al.,* 2005; Fildes and Howell 1979; Makridakis and Hibon,1979).ARIMA models were popularized by George Box and Gwilym Jenkins (B-J) in the ear1y1970s and their names have frequently been used synonymously with general ARIMA models applied to time series analysis and forecasting (Makridakis *et* a1.,1981). As far as Bangladesh economy is concerned, to the knowledge of the author, there is no satisfactory forecasting model for univariate model (ARIMA) which was used for export earning especially agriculture and fresh fruits and vegetable in Bangladesh has yet to have been developed. Some works have been done for growth analysis in vegetables area, production and productivity of vegetables by different authors using deterministic model (Sabur,1990).Many of the researchers' attempts however, have been is made to explain the behaviour of the agricultural commodity and industrial production on sector basis (Sabur and Haque,1993,Haque *et al.,* 2005;; Dutta,1993), which did not attempt to forecast the future behaviour and also not substantiated by sophisticated econometric analysis. A number of attempt are made for other countries viz., for Tamil Nadu (Mani *et al.,* 2000), Pakistan (Afzal *et al.,* 2002), Thailand (Weesakul, 2005) etc that use mainly univariate models and provide satisfactory forecast results. In this light, the study employed the BoxJenkins models on the total and agricultural export, especially vegetables and fruits export earning data because these techniques are designed to handle properly autocorrelation issues (Box-Jenkins.1976).

The present study employed the Univariate Box-Jenkins (UBJ) modeling strategy on the total export earnings especially agricultural, vegetables and fruit data because the UBJ model has three specific advantages over many other traditional single-series methods. Firstly, the concept associated with UBJ models are derived from solid foundation of classical probability theory and mathematical statistics. Secondly, ARIMA models are a family of models, not just a single model. Box and Jenkins developed a strategy that guide the analyst in choosing one or more appropriate model(s) out of a larger family of models. Thirdly, it can be shown that an appropriate ARIMA model produces optimal univariate forecasts (Ali, 2005). If the ARIMA Box-Jenkins time series models provide an adequate fit to the data, they will produce one-step-ahead minimum variance forecast of the process. In order to apply Box-Jenkins methods to time series data, the series must meet certain stationarity assumptions; the series must be stationary in both mean and variance across the modeling period. For those data series stationary in both the mean and variance, should applied Box-Jenkins (Box and Jenkins, 1976, Makridakis *et al.*, 1983 and Pankratz, 1983). In the case of ARIMA forecasting we extrapolate past patterns within a single data series into future. Box-Jenkins processes an entire family of models called ARIMA models that seem applicable to a wide variety of situations. They have also developed a practical procedure for choosing an appropriate model out of this family of ARIMA models. Many authors (Hwamg and Ang, 2002, Barras, 1993, Chow and Choy,1993, Cleary and Levenbach,1982, Hanke and Reitsch,1986, Herbest,1992 and Nazem, 1988) suggested that building a proper ARIMA model is an art, which required good judgment and a lot of experience. For aforesaid cause of in order to forecasting export earnings from Bangladesh especially agricultural and vegetables ARIMA models were selected.

II. METHODOLOGY

All the statistical forecasting methods are extrapolative in nature. They were involved the projection of past pattern into the future. In case of Autoregressive Integrated Moving Average (ARIMA) forecasting extrapolate past patterns within a single data series into the future. In the present study, ARIMA models were constructed to forecast the Agricultural export from Bangladesh earnings especially consider total export, fruits and vegetables using time series data from 1972-73 to 2005-06 for total and agricultural export earnings and from 1980-81 to 2005-06 for vegetables export earning. The Box-Jenkins approach was used forecasting of export earnings from Bangladesh. Box-Jenkins proposed an entire family of models called ARIMA models. They developed a practical procedure for choosing an appropriate model out of this family of ARIMA models. However, selecting an appropriate model may not be easy. Many authors suggested that building a proper ARIMA model is an art, which requires good judgment and a lot of experience. The following criteria were used for selecting the best fitted export model. The criterion are : Coefficient of determination (R^2), Adjusted Coefficient of determination, Root mean square error (RMSE), Akaike information criterion (AIC) alternatively called Bayesian Information criteria (BIC), Schwartz Information Criterion (SIC); Mean Absolute Error (MAE); Mean Absolute Percent Prediction Error (MAPPE). The basic steps in the Box-Jenkins methodology (Box-Jenkins, 1976) are (i) Differencing the series so as to achieve stationary, (ii) identification, (iii) estimation, (iv) diagnostic checking, and (v) forecasting. The ordinary algebraic for two common ARIMA processes, the AR (1) and the MA (1) are respectively, $Y_t = \mu + \phi_1 Y_{t-1} + \varepsilon_t$; $Y_t = \mu - 6_1\varepsilon_{t-1} + \varepsilon_t$,Where μ is an intercept term, ϕ is the coefficient of an auto regression term, 6 is the coefficient of moving average term, and a is white noise. Similarly, AR (2) process, MA (2) process and ARIMA (1, 1) process are respectively, $Y_t = \mu + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \varepsilon_t ; Y_t = \mu - 6_1\varepsilon_{t-1} + 6_2\varepsilon_{t-2} + \varepsilon_t$ $Y_t = \mu + 6_1 Y_{t-1} - 6_1\varepsilon_{t-1} + \varepsilon_t$. Although ARIMA (p, d, q) is enough to express an ARIMA model with the parameters p, d, q, it is advisable to take at the equation of ARIMA(p, d, q) model in a bit different form, which is commonly used and known as back shift notation of ARIMA model. Here the back shift operator B is used to denote the time back i.e., if the Y_t is multiplied by B, Y_{t-1} is obtained i.e., $BY_t = Y_{t-1}$, $B^2 Y_t = Y_{t-2}$ and so on .So, $(1-B)Y_t = Y_t - Y_{t-1}(1-B)^2 Y_t = Y_t - 2Y_{t-1} + Y_{t-2}$. $(1-B)^2 Y_t$ is a compact and convenient way of writing the second difference of r_t.Thus a non-seasonal ARIMA (p,d,q) process in back shift notation has the general form as: $(1-\varphi_1 B - \theta_2 B^2 \ldots\ldots\ldots - \theta_p B^p)(1-B)^d Y_{-t} = (1-\theta_1 B - \theta_2 B^2 \ldots\ldots - \theta_p B^p)\varepsilon_t$; where Y_{-t} is the dth- differenced series of Y_t measured from mean of the d^{th}-differenced series .In case any constant term π occurs in the estimated equation, it is to be placed on the right-hand side as an additional term. A more compact form that often appears in time series literature is as follows: Let $\Delta^d = (1-B)^d$, $\varphi(B) = (1-\varphi_1 B - \varphi_2 B^2 \ldots\ldots - \theta_2 B^p)$and $\theta(B) = (1-\theta_1 B - \theta_2 B^2 \ldots\ldots - \theta q B^q)$; Then the general compact form of ARIMA (p, d, q) process becomes (Box-Jenkins,1976);

$$\phi(B)\left(\Delta^d Y_t - \mu\right) = \theta(B)\varepsilon_t$$

Y_t = Total export, agricultural export, vegetable export and fruits export earnings in million dollars

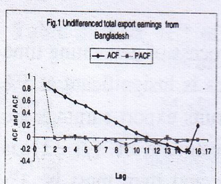
where $\mu = The\ mean\ of\ \nabla^d Y_t$

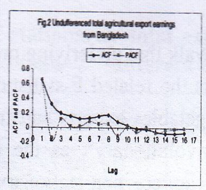
$$\phi(B) = 1 - \phi_1 B - \phi_2 B^2 - ...... - \phi_p B^p \quad \theta(B) = 1 - \theta_1 B - \theta_2 B^2 - \ ...... - \theta_q B^q \ .$$

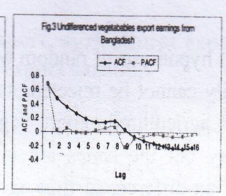
III. RESULTS AND DISCUSSION

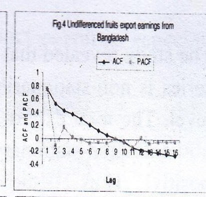
Test of stationarity using Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF)

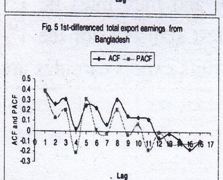
Autocorrelation function is a very constructive tool to find out whether a time series is stationary or not. Both ACF and PACF are used to determine auto-regression and moving average orders of the models. ACF and PACF of total export, agricultural exports, fruits and vegetable export earnings are shown in Figures 1, through Figures 4. All the graphs show that autocorrelations taper of very slowly is indicating that all the series are non-stationary. It is needed to take difference of all the time series and construct autocorrelation functions to examine the time series are stationary or not. The autocorrelation functions of 1st differenced time series of total export, agricultural export and vegetable export earnings are presented in Fig. 5, Fig. 6 Fig. 7 and Fig. 8, respectively. The 1st differenced total export earnings seems to be stationary, as the autocorrelation decline faster but agricultural export and vegetables export earnings are still non-stationarity, as the autocorrelation declines slowly. So, the time series have to be examined the stationarity of 2nd-diiferenced series of agricultural export fruits and vegetables export earnings. The autocorrelation function of 2nd-differenced time series of total export earnings and earning from export of agricultural products, fruits and vegetables are shown in Fig. 9, Fig.10 and Fig.11 and Fig.12 respectively. It is observed that ACF of all the 2nd-differenced series declines rapidly and remains small. So, agricultural export, fruits and vegetables export earnings are stationarity of order two and the total export earning is stationary of order one or two. Before taking the decision about stationarity of the series the study needs to carry out the ADF (Augmented Dickey -Fuller) test of stationarity.

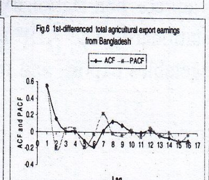


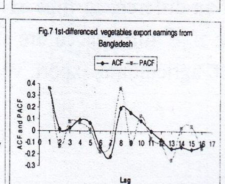


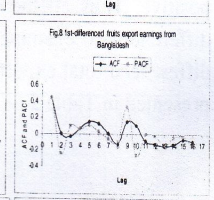


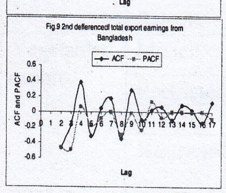


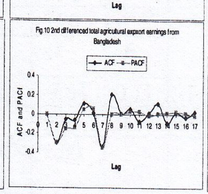


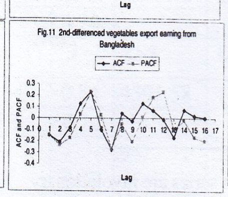


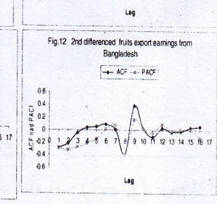












Test of stationarity using Augmented Dickey-Fuller test (ADF)

Apart from the graphical methods of using ACF for determining stationarity of a time series, a very popular formal method of determining stationarity is the Augmented Dickey-Fuller test. Here, this test was done for the test of stationarity for all the time series data. The estimates of necessary parameters and related statistics for the time series of total export, agricultural export, vegetables export and fruits export earnings are presented in Table 1.

Table 1. ADF test of stationarity total export, agricultural export earnings especially vegetables and fruits level export earnings (Base year 1982-83)

Area	Model	α	β	(ρ-1)	λ	RSS	DF	DW	F	$F_{05,34}$
Total export	Unrestricted	-6.20	0.86	0.03	-0.03	5827.73	28	1.98	2.25	
	S.Error	7.65	0.71	0.05	0.20					
	Restricted	8.69			0.44	8651.50	30	2.14		
	S.Error	3.76			0.15					
Agricultural export	Unrestricted	-9.55	0.83	0.007	0.52	14909.18	28	1.99		7.06
	S.Error	10.85	0.87	0.30	0.42				1.66	
	Restricted	5.06			0.65	16564.43	30	2.01		
	S.Error	4.34			0.16					
Vegetables export	Model	α	β	(ρ-1)	λ	RSS	DF	DW	F	$F_{05,26}$
	Restricted	-4.34	0.35	0.15	0.30	4240.68	20	1.74		
	S.Error	8.18	0.88	0.21	0.32				2.28	
	Restricted	4.50			0.63	5120.35	22	1.72		7.22
	S.Error	3.39			0.24					
Fruits export	Unrestricted	-4.30	0.23	0.26	-0.37	62616.14	20	1.89	5.27	
	S.Error	38.37	4.54	0.26	0.33					
	Restricted	27.10			0.09	84652.6	22			
	S.Error	13.81			0.20					

The study revealed that hypothesis of random walk that underlying process of generating time series is non-stationarity cannot be rejected, as the related F-statistics is insignificant at 5% level. The total export, agricultural export, vegetables exports and fruits export earnings are not only non-stationary but the series are involutionary[2], as the estimate of $(\rho\text{-}1)$ is positive. Thus all the un-differenced time series are non-stationary and they must be 1st differenced to examine if 1st-differenced are stationarity. The ADF test statistics for the 1st differenced total export, agricultural export, vegetables export and fruits export earnings are presented in Table 2.

[2] When $(\rho\text{-}1) > 0$, the series are involutionary.

Table 2. ADF test of stationarity total export, agricultural export earnings especially vegetables and fruits 1st different export earnings

Area	Model	α	β	$(\rho-1)$	λ	RSS	DF	DW	F	$F_{05,34}$
Total export earnings	Unrestricted	-10.92	1.42	-1.09	0.09	5850.08	27	1.92		
	S.Error	6.69	0.43	0.29	0.20					
	Restricted	2.39			-0.46	9044.37	29	1.11	8.19	
	S.Error	3.18			0.16					
Agricultural export earnings	Unrestricted	-10.80	0.89	-0.45	-0.01	14852.83	27	1.98		7.08
	S.Error	10.19	0.51	0.32	0.36					
	Restricted	4.00			-0.36	16991.74	29	2.00	2.16	
	S.Error	4.42			0.19					
Vegetables export earnings	Model	α	β	$(\rho-1)$	λ	RSS	DF	DW	F	$F_{05,26}$
	Restricted	-9.06	1.04	-0.76	0.23	4170.03	19	1.80		
	S.Error	7.78	0.51	0.36	0.29					
	Restricted	2.82			-0.16	5490.22	21	1.97	3.48	7.22
	S.Error	3.39			0.22					
Fruits export earnings	Unrestricted	-31.69	3.83	-0.66	-0.38	60836.80	19	1.91	3.00	
	S.Error	30.11	2.08	0.45	0.32					
	Restricted	12.06			-0.76	73016.46	21	2.10		
	S.Error	12.39			0.16					

The analysis found that first difference of total export earnings is stationary but that of agricultural export, vegetables export and fruits earnings are non-stationary, as the F-tests were insignificance at 5% level. No 1st-differenced series is found to be involutionary. Further, the series will have to be differenced once in order to see the stationary. The 2nd differenced results of ADF test for agricultural export and vegetables export earnings are shown in Table 3.

Table 3. ADF test of stationarity total export, agricultural export earnings especially vegetables and fruits 2nd-different export earnings

Area	Model	α	β	$(\rho-1)$	λ	RSS	DF	DW	F	$F_{05,33}$
Total export	Unrestricted	-3.46	0.37	-2.23	0.51	6555.32	26	1.95	34.34	
	S. Error	7.16	0.33	0.29	0.16					
	Restricted	-0.13			-0.60	21565.92	28	2.82		
	S. Error	5.06			0.15					7.24
Agricultural export	Unrestricted	-11.10	0.82	-1.69	0.21	15453.72	26	2.00	13.15	
	S. Error	11.27	0.54	0.35	0.26					
	Restricted	0.35			-0.81	29009.23	28	2.16		
	S. Error	5.90			0.20					
Vegetables export	Model	α	β	$(\rho-1)$	λ	RSS	DF	DW	F	$F_{05,26}$
	Restricted	-7.64	0.71	-1.64	0.34	4591.58	18	2.12	11.57	
	S. Error	9.03	0.54	0.38	0.24					
	Restricted	1.60			- 0.49	9421.71	20	2.35		7.22

	S. Error	4.63			0.20					
Fruits export	Unrestricted	-39.28	5.07	-1.52	-0.51	57488.59	18	2.30	22.65	
	S. Error	32.82	2.14	0.29	0.11					
	Restricted	0.73			-0.91	144311.0	20	2.69		
	S. Error	18.13			1.33					

It is shown that all the 2nd-differenced of agricultural export and vegetables export earnings are stationarity, as the F statistics are significant at 5% level. From the ACFs and ADF test, decision could be taken that total export earnings are stationarity of order one but agricultural export and vegetables export earnings series are stationarity of order two.

Selection of best model for total exports

The first step of Box-Jenkins methodology for selecting the ACF and the PACF plots of the total export earnings series at their level up to 16 lags and at first difference are considered and observed. The ACF has seven significant spikes at the beginning while the PACF has only one significant spike at the beginning. But, the ACF plots of first difference series are showing one significant spike at first lag. It is also evident from figure 5 that all the ACF plots are within the 95% confidence limits. This implies that original series is non-stationary at their levels and stationary at first difference. Thus, the value of the second parameter'd' of ARIMA model is tentatively selected as 1.The second step of identification is to assess the appropriate ARIMA specification of the stationary series. This is examined by the observing the ACF and PACF plots depending on the fact that for a pure auto-regressive process of order 'p' the PACF up to lag p will have significant spikes, while beyond that all of them are expected to be zero. But the ACF will decline asymptotically towards zero and does not exhibit any discrete cut off point. For a pure moving average process of order 'q' significant spikes up to lag q and PACF plots have exponentially declining values. Figure 1 is showing that the PACF plots have precisely 1 significant spike at the beginning. Thus, the orders of auto-regression and moving average process tentatively selected as 1 and 7 respectively.

A total of eight models with tentatively selected different values of p, d, q described are estimated by computer using SPSS software. The tentatively selected models are mentioned as : ARIMA (1,1,1), ARIMA (1,1,0), ARIMA (1,1,3), ARIMA (1,1,8), ARIMA (2,1,2), ARIMA (2,1,3) and ARIMA (2,1,1). The minimum values of AIC and BIC are selected as candidate for final models. These models are again compared according to the minimum values of RMSE, MAE, MAPE, high value of R^2 and χ^2 insignificant values suggested that ARIMA (1,1,8) are the best models.The result being statistically insignificant gives the impression that the residuals estimated from the ARIMA (1,1,8) model purely random. Hence, it was concluded that ARIMA (1, 1,8) is the best fitted model for forecasting the total export earnings in Bangladesh. So, the structure of the model ARIMA (1,1,8) for forecasting the total export earnings for series from 1972-73 to 2005-2006 with base 1982-83 in Bangladesh using the back shift operator is as follows:

$$(1-0.94B)(\Delta Y_t - 18.33) = (1-0.66B-0.20B^2+0.32B^3-0.31B^4+0.07B^5+0.31B^6-0.47B^7+0.66B^8)\varepsilon_t$$

$$SE=(0.13) \quad (14.53) \quad (684.96)\,(203.80)\,(105.75)\,(105.34)\,(302.03)\,(218.29)\,(269.48)(334.56)$$

Table 4. Selection criteria for total export earning of best fitted models sample period

Model	Values of selection criteria							
	R^2	RMSE	AIC	BIC	MAPE	MAE	χ^2 (BL at 16 lag)	P-value
ARIMA(1,1,1)	0.98	15.52	186.99	191.48	12.36	10.34	10.68	0.82
ARIMA(1,1,0)	0.98	16.36	188.46	200.82	16.34	12.45	17.68	0.34
ARIMA(1,1,3)	0.98	14.32	185.85	193.15	12.91	9.66	5.04	0.99
ARIMA (1,1,8)	0.99*	**11.24***	**185.67***	**191.46***	**12.00***	**8.03***	**4.05***	**0.99***
ARIMA(2,1,2)	0.98	15.30	190.07	197.56	12.29	10.41	10.57	0.83
ARIMA(2,1,3)	0.98	15.55	193.11	202.09	12.35	10.26	10.02	0.86
ARIMA(2,1,1)	0.98	15.52	188.99	194.97	12.33	10.34	10.78	0.83
Quadratic	0.98	15.59	192.79	197.37	21.57	13.13		

Note: The value of the criterion for a model with asterisk shows that the model is better than other models with respect to that criterion

From the above table it is observed that the model ARIMA (1,1,0) is better than the other models in case of BIC but ARIMA (1,1,8) is better for the remaining criteria. So the study selects ARIMA (1, 1, 8) as the best model. Again, R^2 0.98 is lower and AIC (192.79), BIC (197.37) and MAPE (21.57) is higher for quadratic model compared to ARIMA (1,1,8) . This measure indicates that the forecasting ARIMA model is more accurate than that of the deterministic model. Similar results were also found by Raid (1971), Groff (1973), Adam (1973), Newbold and Granger (1974), Geurtz and Ibrahim (1975).

Forecasting of total export earnings

Five-year forecast is used to make with 95% confidence interval of total export earnings estimated by using the best selected models are presented in Table 5. An important limitation of making forecasts is that forecasting error increasing as the period of forecast increases. For this reason short-term forecast is more reliable compared to long term forecast.

Table 5. Forecasting total export earnings

Year	ARIMA (1.1.8)					Quadratic			
	LPL	Forecast	UPL	SE	UPL-LPL	LPL	Forecast	UPL	UPL-LPL
2006-07	497.01	526.48 (10%)	555.95	14.24	58.94	446.59	484.55	522.51	75.92
2007-08	511.05	558.91 (6%)	606.76	23.14	95.71	479.66	518.72	557.78	78.12
2008-09	538.98	602.37 (8%)	665.75	30.64	126.77	513.75	554.09	594.43	80.68
2009-10	542.42	625.52 (4%)	708.61	40.17	166.19	548.85	590.66	632.48	83.63
2010-11	547.21	647.3 (4%)	747.53	48.42	200.32	584.96	628.44	671.92	86.96

SE= Standard Error, LPL= Lower Predicted Limit, UPL= Upper Predicted Limit. Figures in the parenthesis indicates percentage of export earning than to the previous year

ARIMA forecasts are higher than the deterministic (quadratic model) forecasts. The forecast values and confidence intervals reveal that forecasting error sufficiently small and consequently the intervals are not too large. The ARIMA model estimated that the export earning is $526 million in 2006-07 and if the present export earnings continue the total export earnings of Bangladesh would be $647.37 million in the year 2010-2011 with approximately plus/minus $100.16 million (Range from $747.53 million to $ 547.21 million). The percent change of export earning over previous year which decreased to 4% in 2010-11.To increase vegetables export earning the government of Bangladesh may initiates cash incentive to exporter in order to achieve millennium development goal.

Best model of agricultural export

The ACF and the PACF of the agricultural export earnings are plotted at their level first difference and 2nd-difference up to 16 lags. The ACF as well as PACF has one significant spike at the beginning. But, the ACF plots of first difference series are showing one significant spike at the beginning. The ACF and PACF plots of 2nd-diffrence are showing one significant spike at lag 6. It is also evident that all the ACF plots are within the 95% confidence limits. This implies that original series is non-stationary at their level and stationary at 2nd-difference. Thus, the value of the second parameter'd' of ARIMA model is tentatively selected as 2. Figure 5 is shows that the PACF plots have precisely 1 significant spike at the lag 6. Thus the orders of auto-regression and moving average process tentatively selected as 6. A total of five models with tentatively selected different values of p, d, q are estimated.The tentatively selected models are mentioned as: ARIMA (6,2,4), ARIMA (6,2,5), ARIMA (6,1,6), ARIMA (6,2,8) and ARIMA (6,2,9). For selecting best model, the minimum values of RMSE, MAE, MAPE, AIC and BIC and high value of R^2 and χ^2 values were considered. It was observed that ARIMA (6,2,6) model possesses the minimum value of these criteria (except AIC and BIC) and it describes the data generating process very precisely. Ljung-Box statistics (Table 6) indicates that the residuals estimated from the ARIMA (6,2,6) model purely random. Hence, it is concluded that ARIMA (6,2,6) is the best fitted model for forecasting the agricultural export earnings from Bangladesh. Thus, the structure of the model ARIMA (6,2,6) for forecasting the agricultural export earnings for the series in Bangladesh using the back shift operator and necessary statistics are given below:

$$(1+0.27B+0.11B^2+0.30B^3+0.005B^4+0.09B^5+0.62B^6)(\Delta^2Y_t-1.19)$$
$$SE=(1.03)\quad(1.16)\quad(1.29)\quad(0.83)\quad(0.91)\quad(0.93)\quad(0.66)$$
$$=(1+0.10B-0.20B^2+0.62B^3+0.0.11B^4-0.28B^5-0.28B^6)\varepsilon_t$$
$$SE=(639.03)\,(704.08)\quad(687.61)\,(287.76)\,(359.52)\quad(180.41)$$

Table 6. Selection criteria for agricultural export earnings best fitted models, Sample period)

Model	Values of selection criterea							
	R^2	RMSE	AIC	BIC	MAPE	MAE	χ^2 (BL at 16 lag)	P-value
ARIMA(6,2,4)	0.95	15.68	198.15	214.27	14.50	10.65	2.47	0.99
ARIMA(6,2,5	0.95	15.54	199.58	217.17	14.96	10.52	2.56	0.99
ARIMA(6, 2,6)	**0.95***	**15.12***	**195.53***	**209.09***	**14.15***	**10.11***	**2.36***	**0.99**
ARIMA(6, 2,8)	0.95	15.31	204.65	226.64	14.50	10.14	2.41	0.99
ARIMA(6, 2,9)	0.95	15.25	205.86	229.31	14.64	10.17	3.45	0.99
Cubic	0.86	29.15	233.33	236.39	26.8	17.35		

Note: The value of the criterion for a model with asterisk shows that the model is better than other models with respect to that criterion

From the above table it is observed that the model ARIMA (6,2,6) is better for all the others model. So it is select ARIMA (6,2,6) as the best model. The cubic model produced higher AIC, BIC, RMS, MAPE and MAE compared to ARIMA (6,2,6). So, it is concluded that ARIMA Model is more appropriate for forecasting compared to deterministic model.

Forecasting of agricultural export earnings

A five-year forecast with 95% confidence intervals of agricultural export earnings as estimated using the best selected models are presented in Table 7. The study tried to develop a short run-forecasting model of agricultural export earning. As vegetables export share over half of agricultural export, forecasting of agricultural export is necessary for better understanding the forecast of vegetables export. In attempting to do so the author introduced several ARIMA models and based on diagnostic tests the study finally chose ARIMA (6,2,6) model.

Table 7. Forecasting agricultural export earnings

Year	ARIMA (6,2,6)					Cubic			
	LPL	Forecast	UPL	SE	UPL-LPL	LPL	Forecast	UPL	UPL-LPL
2006-07	341.24	383.82 (13%)	426.40	20.34	85.16	108.20	202.68	297.16	188.96
2007-08	304.37	396.52 (4%)	488.66	44.02	184.29	123.11	220.33	317.55	194.44
2008-09	292.62	444.62 (12%)	596.61	72.62	303.99	138.28	238.69	339.10	200.82
2009-10	248.01	446.71 (1%)	645.40	94.93	397.39	153.70	257.77	361.84	208.14
2010-11	168.50	418.26 (-6%)	668.02	119.4	499.52	169.34	277.56	385.78	216.44

SE= Standard Error, LPL= Lower Predicted Limit, UPL= Upper Predicted Limit

It is revealed from the analysis that ARIMA forecasts are higher than the deterministic (cubic) models. If the existing agricultural export earnings continue, Bangladesh would experience 13% higher export in 2006-07 over previous year. However, in 2010-11, the export would be 6% lower than a year earlier. So, the government of Bangladesh should take proper agricultural export policy for the development of this sector

Best model for vegetables export

Figure 6 represent the ACF plots and the PACF plots of the vegetables export earnings series at their level up to 16 lags. From this Figure it is revealed that at the beginning ACF has three significant spikes and PACF has only one significant spike. The first difference (Figure 7) and 2^{nd}-differenced (Figures 11) plots of ACF and PACF are showing a different configuration. The ACF plots of first difference series are showing one significant spike at the beginning. The ACF and PACF plots of 2^{nd}-diffrence are showing one significant spike at the lag 7. It is also evident from figure 8 that all the ACF plots are within the 95% confidence limits. This implies that original series is non-stationary at their levels and stationary at 2^{nd}-difference. Moreover, the residuals are uncorrelated. Six models at different values of p, d, q are estimated using the same packages as mentioned in the previous section. The models are ARIMA (1,2,0), ARIMA (1,2,1), ARIMA (1,2,2), ARIMA (1,2,3), ARIMA (2,2,2) and ARIMA (2,2,3,). Out of these models the minimum values of RMSE, MAE, MAPE, AIC and BIC but high value of R^2 and χ^2 suggest best selected ARIMA (1,2,1) models. The results of Ljung-Box statistics (presented Table 8) is found to be statistically insignificant which means that the residuals estimated from the ARIMA (1,2,1) model are purely random. The ARIMA (1,2,1) is the best fitted for forecasting the vegetables export earnings from Bangladesh. The model with estimated parameters, standard error is given below:

$$(1-0.53B)(\Delta^2 Y_t - 1.44) = (1-0.99)\varepsilon_t$$

$$SE = (0.28) \quad (0.75) \quad (7.07)$$

Table 8. Diagnostic tools and model selection criteria for vegetables export earning of best fitted models

Model	Values of selection criteria							
	R^2	RMSE	AIC	BIC	MAPE	MAE	χ^2 (BL at 16 lag)	P-value
ARIMA(1,2,0)	0.93	15.12	134.39	136.75	36.96	9.93	12.33	0.72
ARIMA(1,2,1)	**0.95***	**11.20***	**132.31***	**136.23***	**32.01***	**8.08***	10.19	**0.86**
ARIMA (1,2,2)	0.93	13.79	133.97	138.68	32.99	8.93	8.76	0.92
ARIMA(1,2,3)	0.93	13.78	135.92	141.81	32.06	8.99	8.30	0.93
ARIMA(2,2,2)	0.94	12.78	132.69	138.21	39.28	9.17	7.34	0.96
ARIMA(2,2,3)	0.94	12.76	134.23	141.30	39.03	9.20	6.89	0.97
Cubic	0.91	12.82	140.68	145.72	78.63	9.45		

Note: The value of the criterion for a model with asterisk shows that the model is better than other models

From the above table it is observed that the model ARIMA (1,2,1) is better than the all other models. So, the ARIMA (1, 2, 1) is the best model for forecasting vegetables exports earnings. The AIC (140.68), BIC (145.72) and MAPE (78.63) for cubic model is higher than ARIMA (1,2,1) model. So, the ARIMA models are better than the respective deterministic models.

Forecasting of vegetables export earnings

Five-year forecasting with 95% confidence interval of vegetable export earnings are estimated using the best selected models and are presented in Table .9. The prediction period was extended from 2006-07 to 2010-11. By using ARIMA model is closer to the actual values of the variables of that period than the forecast estimated by using deterministic model. The forecasting value of ARIMA model was $239.60 million and Cubic model was $193.54 million in the year of 2006-07. Accuracy measures showed consistently that the error was relatively higher forecasts obtained by deterministic models than those obtained by ARIMA model. Thus the performance of ARIMA model was better than that of the deterministic model for future decision making.

Table 9. Forecasting vegetables export earnings

Year	ARIMA (1,2,1)					Cubic			
	LPL	Forecast	UPL	SE	UPL-LPL	LPL	Forecast	UPL	UPL-LPL
2006-07	207.04	239.60 (23%)	272.16	15.65	65.12	154.38	193.54	232.69	78.31
2007-08	215.49	278.92 (16%)	342.36	30.50	126.87	181.25	226.41	271.54	90.29
2008-09	220.23	315.25 (13%)	410.27	45.69	190.04	209.95	263.09	316.24	106.29
2009-10	223.71	350.65 (11%)	477.59	61.04	253.88	240.63	303.85	367.06	126.43
2010-11	226.98	386.24 (10%)	545.50	76.58	318.52	273.49	348.87	424.24	150.75

SE= Standard Error, LPL= Lower Predicted Limit, UPL= Upper Predicted Limit

ARIMA forecasts are higher than the deterministic forecasts. Deeply observing the forecasted values and confidence intervals presented in Table 9 reveal that forecasting error sufficiently small and consequently the intervals are too large. The forecasting found that if the existing vegetables export earnings continue, Bangladesh would obtain 23% growth in the year 2006-07 but it would decrease by 10% in the year of 2010-11. Therefore, the government of Bangladesh should take cash incentive export policy for the development of this sector. Since vegetables are perishable, high fluctuation & vegetables prices would make vegetables export earnings very much uncertain. The export price uncertainty of vegetables can be minimized if prices can be forecasted well ahead so that necessary step can be taken against losses. For that purpose, the government and fresh vegetables exporters association as well may use ARIMA model because ARIMA model as shown is good enough to forecast future export price more accuracy in the short period.

Selection of best model of fruit export earnings

Figures 4 and Appendix Figures 9 represent the ACF and the PACF of the fruits export earnings series at 16 lags. The ACF have four significant spikes at the beginning while the PACF have one significant spikes at the beginnings. Figures 9, representing the ACF and PACF plots of fruits export earnings series of Bangladesh at first difference. The ACF and PACF of 2nd-diffrence given in Appendix Figure 11 show one significant spike at the lag 8. This implies that original series is non-stationary at their level and stationary at 2nd-difference. Moreover, the residuals are uncorrelated. Thus, the value of the second parameters of ARIMA model is tentatively selected as 2. Five models at different values of p,d, q are estimated namely: ARIMA(8,2,3), ARIMA (8,2,4), ARIMA (8,2,6), ARIMA (8,2,7) and ARIMA (8,2,8). The minimum values of RMSE, MAE, MAPE, AIC and BIC but high value of R^2 and χ^2 suggests best-selected ARIMA models. Table 10 representing the values of the criteria of the competing ARIMA models. The values of the criteria suggest that the ARIMA (8,2,8) models is best fitted model. The structure of the selected model using the back shift operator is as follows:

$$(1+0.56B+0.63B^2+0.61B^3+0.83B^4+0.57B^5+0.43B^6+0.33B^7+0.66^8(\Delta^2Y_t-0.003)$$
$$SE=(2.54)\ (2.90)\ \ (3.40)\ \ (3.27)\ \ (3.18)\ \ (3.21)\ \ (2.25)\ \ (2.39)\ \ (0.002)$$

$$=(1+0.32B+0.04B^2-0.42B^3-0.07B^4+0.29B^5+0.71B^6+0.44B^7-0.33B^8)\varepsilon_t$$
$$SE=(7.85)\ \ (33.93)\ \ (6.28)\ \ (34.83)\ \ (11.27)\ \ (34.14)\ \ (14.44)\ \ (10.88)$$

Table 10. Selection criteria for fruits export earnings of best fitted models

Models	Values of selection criteria							
	R^2	RMSE	AIC	BIC	MAPE	MAE	χ^2 (BL at 16 lag)	P-value
ARIMA(8,2,3)	0.98	30.71	188.38	202.52	22.16	21.00	8.66	0.93
ARIMA(8,2,4)	0.98	30.41	189.91	205.22	21.93	20.85	8.90	0.91
ARIMA(8,2,6)	0.98	26.79	187.83	205.50	21.97	20.41	9.81	0.87
ARIMA(8,2,7)	0.98	25.95	188.29	207.14	21.85	19.92	9.44	0.89
ARIMA(8,2,8)	**0.98**	**25.59***	**184.35***	**188.58***	**21.14***	**19.61***	**8.09**	**0.95**
Cubic	0.95	36.12	194.53	199.56	68.90	24.23	-	-

Note: The value of the criterion for a model with asterisk shows that the model is better than other models with respect to that criterion

From the Table it is observed that the model ARIMA (8,2,8) is better than the other models. So, ARIMA (8,2,8) is the best model for fruit export earnings from Bangladesh. The AIC (194.53), BIC (199.56) and MAPE (68.90) for cubic model is higher than ARIMA (8,2,8) model. So, the ARIMA models are better than the respective deterministic models.

Forecasting of fruits export earnings

Table 11 revealed that the forecasting value of fruit exports were \$0.74 million for ARIMA model and \$0.75million for Cubic model in the year 2006-07 but upper limit was higher for cubic model compared to ARIMA model. So the forecasting of ARIMA models is more efficient to the deterministic models. The forecasting value increased gradually over period under considered.

Table 11. Forecasting fruit export earnings

Year	ARIMA (8,2,8)					Cubic			
	LPL	Forecast	UPL	SE	PL-LPL	LPL	Forecast	UPL	UPL-LPL
2006-07	0.64	0.74	0.84	0.04	0.20	0.64	0.75	0.86	0.22
2007-08	0.52	0.73	0.94	0.09	0.42	0.74	0.86	0.99	0.25
2008-09	0.43	0.75	1.04	0.12	0.61	0.84	0.99	1.14	0.30
2009-10	0.52	0.88	1.24	0.15	0.72	0.96	1.13	1.31	0.35
2010-11	0.67	1.06	1.45	0.16	0.78	1.07	1.28	1.50	0.43

SE= Standard Error, LPL= Lower Predicted Limit, UPL= Upper Predicted Limit

The findings of the study revealed that if the present fruit export continues the earnings of Bangladesh would be $1.06 million in the year 2011-2012 the variation of from $0.67 to $1.45 million.

IV. CONCLUSION

The ARIMA model was more appropriate followed by deterministic model for forecasting exporting earnings. The study tried to develop a short-run forecasting model of export earnings from Bangladesh. The ARIMA (1,1,8) was finally chosen for total export, ARIMA (6,2,6) for agricultural export and ARIMA (1,2,1) vegetables exports and ARIMA (8,2,8) for fruits export earnings. The percent of export earning was 10% in 2006-07 which would gradually increase up to year 2008-09 and it would remain same till 2010-11. Therefore, the export will increase, if the government of Bangladesh initiates cash incentive export policy for the achievement of millennium development goal. If the existing agricultural export earnings continue, Bangladesh would experience 13 % higher export in 2006-07 but it would -6% in the year of 2010-11. So, the government of Bangladesh should take proper agricultural export policy for the development of this sector. On the contrary, vegetables export earnings in Bangladesh would mark 23 % higher export in 2006-07 but it would decrease 10% in 2010-11. So, the government of Bangladesh should take cash incentive export policy for the development of this sector. In light of the forecast results, policy-makers should gain insight into more appropriate investment promotion strategies. The export uncertainty can be minimized if the export earnings are forecasted well ahead so that necessary steps could be taken against losses. It is strongly recommended that forecasting results of export earnings from Bangladesh were used to implement in export policy making, especially in planning and development in Bangladesh, because these were cost effective and more accurate. The researchers and policy makers will thus get access for making further extensive research work later.

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