

PREDICTION OF AGRICULTURAL GROWTH RATE AS A RESULT OF AGRICULTURAL REFORMS

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ABSTRACT

This study aims to examine the relationship between the level of agrarian reforms actually approved and expressed in Algeria by using data from various fields of statistics, the Ministry of Finance and Agriculture and the World Bank and using the estimation of artificial intelligence techniques. That, as well as the reported availability relationship of advanced agricultural mechanization, is significant. We also find that access to a larger pool of labor increases the validity of self-reports regarding the validity of increased agricultural growth. Moreover, there are overlapping relationships in the various variables of agrarian reforms influencing and mutually influenced. Finally, availability of effective agrarian reforms appears to be the main driver of positive changes in the level of agricultural growth rate.

Keywords: Agricultural reforms, agricultural employment, agricultural mechanization, agricultural growth, artificial intelligence techniques

JEL Classification: C29 ,J01, O13, O49

INTRODUCTION

This is what made Algeria look for sources of income outside the hydrocarbon sector. Likewise, the desire to collect the largest number of the main sources of income for the country, which would enhance its real capabilities within the framework of global competitiveness, by trying to raise the productive capacities in various sectors without the need to resort to those sectors with competitive powers. on the need to gradually upgrade a number of these sectors to be alternatives that can replace the sole supplier (Jerzmanowski ,2009).

The distribution of investment on different sectors of the economy reduces the risks of excessive dependence on one resource or one sector or very few sectors (Stephen. 2003.p.51). While the process of structural transformation of the economy that migrates from an economic fabric dominated by sectors of primary activity (natural resources, agriculture) to secondary sectors (manufacturing industries, agriculture). (Barghouti, 1988).

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The concept of diversification appears as a process of searching for renewable energy, building a non-oil economy and achieving sustainable development (Abdelwalid,2013). Algeria has implemented several development plans and programs, including the program for renewal of Fellahi and Rural (2010-2015) (MADR,2010). Likewise, the five-year extension plan for Fallahi (2015/2019). The 2015-2019 Five-Year Plan: At the end of 2014, the government announced its latest agricultural program, the "2015-2019 Five-Year Plan", which is based on the country's Agricultural and Rural Renewal Policy (PRAR). The program will play a pilot role for the development of the sector until the end of 2019 and will supervise ambitious changes, such as the introduction of advanced techniques in irrigation and a determined policy aimed at increasing the use of water. 'fertilizer. The State will also work to develop the national production of basic products such as potatoes and milk.

According to the FAO, the agricultural capital resource can be expressed in livestock, planted trees, technology in the field of agriculture and agricultural equipment, and the volume of expenditure in the field of land reclamation and structures used in animal production.(Philip^s2019), where it is that the consumption of the agricultural opinion was 15.89 billion dollars during 2014, which was valued at 4.80 million dollars during the year 2000, that is, witnessed a regular rise from one year to another and this is a budget to on the agricultural sector.

LITERATURE REVIEW

The growth of the agriculture sector, agricultural employment, agricultural import and the growth rate of the rural population influence patterns of rural development (Power, 2016). The effects of the growth of the agriculture sector, agricultural employment, agricultural import, and growth rate of rural population on rural development have been explored in several research studies in the past.

Since the development of new rural areas is complex and long-term, it is necessary to develop feasible, responsive and effective scientific mechanisms and policies, ensuring that new rural construction is conducted in a planned manner. Although these views are controversial, they are the basis for socialist countries to build and develop the agricultural sector and rural economies. (Giang and Nguyen ,2016).

Agriculture is the most important occupation in a rural area. Most of the rural population belongs directly or indirectly to the agriculture sector. Agriculture sector grows when there is special interest in agricultural activities, needs and production at different levels.

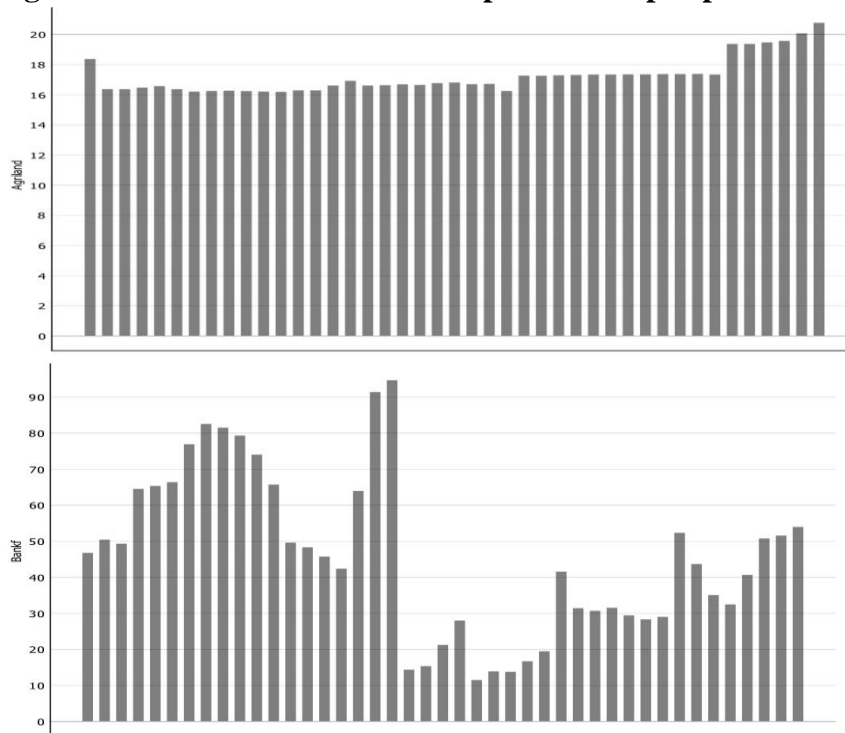
When the agriculture sector grows, there is higher productivity (crops and livestock), better quality and variety of products, and more employment opportunities. The growth of agriculture determines the social welfare of rural people, their way of life, the quality of the natural environment, and the economic development of rural areas(Arif, 2019).

DATA

The data set consists of five inputs: **Bankf**, the volume of agricultural financing, **AgriLand**, the volume of exploited agricultural area, **Agrimach**, the volume of developed agricultural machinery, **Agriwork**, the volume of agricultural labor, and the **rural** level of agricultural growth.

The figure1 describe the statistical analysis of the input parameters with segmentation. The results of the descriptive analysis depend on several input factors. Include analytical parameters used to show relevant values and the sum of all data points for each variable. The figure 2 shows the link diagram. In this scenario, no multicollinearity issues would occur due to the microscopic differences. If there are problems with a multicollinear relationship, then there is a strong influence of the input coefficient between them, which ultimately affects the output results and may provide accurate findings.

Figure 1. The distribution of the input and output parameters.



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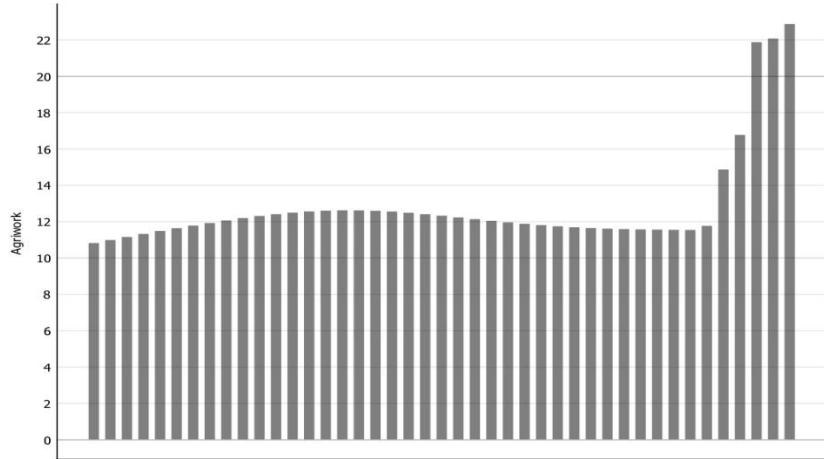
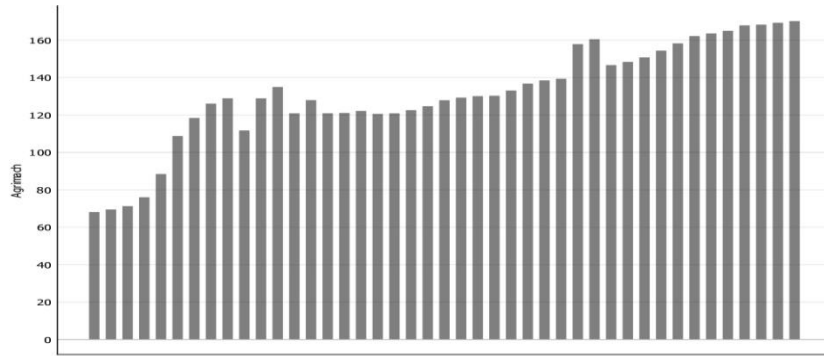


Figure 2. The correlation plot

	1.2219	0.1265	0.0019	0.1052	0.0801	12.4101	0.1011	0.4708	0.2201	0.0310	0.0911	0.1041	0.1654	0.1071	-0.1264	0.0209	14.1000	0.3498	0.3312	0.4135	0.0900
1.2219	0.000	2.092	1.590	1.197	1.184	1.138	2.670	2.123	2.507	2.922	2.546	1.442	1.236	1.994	2.675	2.031	2.321	1.787	2.658	2.127	1.172
0.1265	2.092	0.000	0.588	1.422	1.020	2.486	2.019	1.216	2.249	2.174	2.117	0.658	0.958	0.316	2.601	1.152	3.290	1.056	2.225	1.694	1.132
0.0019	1.590	0.588	0.000	1.238	0.744	2.073	2.089	1.358	2.326	2.263	2.216	0.236	0.688	0.457	2.630	1.292	2.986	1.029	2.321	1.739	0.892
0.1052	1.197	1.422	1.238	0.000	0.525	1.695	2.033	1.232	1.633	2.323	1.687	1.003	0.560	1.462	1.956	1.083	2.650	1.086	1.850	1.301	0.434
0.0801	1.184	1.020	0.744	0.525	0.000	1.749	2.098	1.265	1.965	2.350	1.947	0.515	0.211	1.042	2.292	1.132	2.743	1.009	2.093	1.499	0.165
12.4101	1.138	2.486	2.073	1.695	1.749	0.000	2.963	2.386	2.692	3.217	2.775	1.954	1.780	2.360	2.785	2.292	1.189	2.089	2.844	2.333	1.713
0.1011	2.670	2.019	2.089	2.033	2.098	2.963	0.000	1.006	1.168	0.320	0.871	2.019	1.896	1.913	1.209	1.177	3.544	1.165	0.786	0.884	2.188
0.4708	2.123	1.216	1.358	1.232	1.265	2.386	1.006	0.000	1.083	1.260	0.924	1.245	1.089	1.192	1.402	0.183	3.051	0.434	1.016	0.512	1.334
0.2201	2.507	2.249	2.326	1.633	1.965	2.692	1.168	1.083	0.000	1.455	0.313	2.158	1.831	2.251	0.456	1.110	3.220	1.373	0.439	0.650	1.966
0.0310	2.922	2.174	2.263	2.323	2.350	3.217	0.320	1.260	1.455	0.000	1.154	2.220	2.144	2.055	1.461	1.439	3.774	1.403	1.048	1.195	2.450
0.0911	2.546	2.117	2.216	1.687	1.947	2.775	0.871	0.924	0.313	1.154	0.000	2.069	1.790	2.103	0.571	0.996	3.328	1.233	0.208	0.531	1.973
0.1041	1.442	0.658	0.236	1.003	0.515	1.954	2.019	1.245	2.158	2.220	2.069	0.000	0.454	0.587	2.469	1.160	2.896	0.922	2.186	1.593	0.668
0.1654	1.236	0.958	0.688	0.560	0.211	1.780	1.896	1.089	1.831	2.144	1.790	0.454	0.000	0.943	2.146	0.972	2.749	0.808	1.927	1.330	0.347
0.1071	1.994	0.316	0.457	1.462	1.042	2.360	1.913	1.192	2.251	2.055	2.103	0.587	0.943	0.000	2.562	1.156	3.155	0.946	2.191	1.650	1.179
-0.1264	2.675	2.601	2.630	1.956	2.292	2.785	1.209	1.402	0.456	1.461	0.571	2.469	2.146	2.562	0.000	1.457	3.220	1.638	0.518	0.913	2.299
0.0209	2.031	1.152	1.292	1.083	1.132	2.292	1.177	0.183	1.110	1.439	0.996	1.160	0.972	1.156	1.457	0.000	2.977	0.445	1.112	0.570	1.188
14.1000	2.321	3.290	2.986	2.650	2.743	1.189	3.544	3.051	3.220	3.774	3.328	2.896	2.749	3.155	3.220	2.977	0.000	2.835	3.347	2.942	2.705
0.3498	1.787	1.056	1.029	1.086	1.009	2.089	1.165	0.434	1.373	1.403	1.233	0.922	0.808	0.946	1.638	0.445	2.835	0.000	1.313	0.739	1.110
0.3312	2.658	2.225	2.321	1.850	2.093	2.844	0.786	1.016	0.439	1.048	0.208	2.186	1.927	2.191	0.518	1.112	3.347	1.313	0.000	0.619	2.126
0.4135	2.127	1.694	1.739	1.301	1.499	2.333	0.884	0.512	0.650	1.195	0.531	1.593	1.330	1.650	0.913	0.570	2.942	0.739	0.619	0.000	1.539
0.0900	1.172	1.132	0.892	0.434	0.165	1.713	2.188	1.334	1.966	2.450	1.973	0.668	0.347	1.179	2.299	1.188	2.705	1.110	2.126	1.539	0.000
0.1025	1.510	0.608	0.136	1.103	0.609	2.008	2.061	1.297	2.237	2.251	2.140	0.104	0.558	0.522	2.547	1.218	2.937	0.974	2.253	1.663	0.758
0.1992	2.501	2.273	2.078	2.438	2.320	2.908	1.312	1.820	2.275	1.257	2.041	2.090	2.123	2.032	2.253	1.953	3.589	1.623	1.986	1.827	2.456
0.2803	1.175	1.102	0.858	0.422	1.124	1.710	2.121	1.273	1.919	2.383	1.919	0.630	0.281	1.137	2.249	1.130	2.697	1.042	2.070	1.479	0.070
12.3000	2.402	3.508	3.172	2.839	2.931	1.285	3.729	3.273	3.424	3.955	3.533	3.084	2.938	3.362	3.404	3.203	0.292	3.040	3.548	3.151	2.895
0.3169	2.432	1.831	1.924	1.635	1.783	2.717	0.524	0.664	0.721	0.828	0.436	1.808	1.600	1.782	0.920	0.798	3.325	0.938	0.460	0.432	1.844
0.3918	2.208	1.730	1.838	1.214	1.489	2.416	1.205	0.644	0.554	1.507	0.575	1.669	1.360	1.756	0.961	0.609	3.023	0.949	0.740	0.408	1.492
0.2015	1.231	0.938	0.654	0.586	0.152	1.784	1.971	1.155	1.905	2.215	1.866	0.418	0.082	0.933	2.225	1.035	2.762	0.876	2.004	1.407	0.307
0.2576	2.966	1.965	2.083	2.403	2.320	3.317	0.706	1.333	1.830	0.505	1.523	2.089	2.115	1.830	1.910	1.510	3.923	1.406	1.457	1.449	2.443
19.5460	2.684	3.911	3.548	3.224	3.316	1.614	4.070	3.670	3.787	4.287	3.897	3.465	3.323	3.752	3.736	3.607	0.731	3.426	3.904	3.528	3.283
0.1905	1.780	0.412	0.393	1.191	0.800	2.173	1.784	1.006	2.029	1.962	1.902	0.403	0.678	0.282	2.343	0.950	3.003	0.730	2.001	1.434	0.939

MODEL

To find out the impact of agricultural reforms on the rate of agricultural growth and to predict it in the long term, the following models are used:

Classification Prediction Model Based on LR. The prediction function has the characteristics of high speed, simplicity, and strong generalization ability for new data. It is a linear binary classification model that maps the results of the linear function to the s-type function (sigmoid function). The prediction function of the algorithm is shown

$$h_{\theta} = \frac{1}{1 + e^{\theta T}}$$

In the formula, the value range of $h_{\theta} X$ is between 0 and 1, indicating the probability that the result value is 1.

A substitute for regression methods can be achieved by a statistical technique named regression tree (Breimann,1984). In the regression tree technique, the entire dataset is split into two or more uniform sets to build a model. Upon the termination of the splitting process, a node is named a terminal node. A single value is termed a decision node upon which each node is split into sub-nodes. The recurring binary splitting is used to build a regression tree model with input considerations and a response parameter

$$R_1(j, s) = \{ X | X_j \leq s \} \text{ and } R_2(j, s) = \{ X | X_j > s \}$$

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where s and j are the splitting point and variables, respectively. Further, s and j are used for achieving the most uniform splitting group.

The embedding formulation in (Atkeson,1997). suggests that, once a historical record S is available, the problem of one-step forecasting can be tackled as a problem of supervised learning. Supervised learning consists in modeling, on the basis of a finite set of observations, the relation between a set of *input* variables and one or more *output* variables, which are considered somewhat dependent on the inputs. Once a model of the mapping is available, it can be used for one-step forecasting. In one-step forecasting, the n previous values of the series are available and the forecasting problem can be cast in the form of a generic regression problem.

A multi-step time series forecasting task consists of predicting the next H values $[y_{N+1}, \dots, y_{N+H}]$ of a historical time series $[y_1, \dots, y_N]$ composed of N observations, where $H > 1$ denotes the forecasting horizon. (Casdagli, 1991)

The *Recursive* strategy (Sorjamaa, ,2007) trains first a one-step model f

$$y_{t+1} = f(y_t, \dots, y_{t-n+1}) + w_{t+1},$$

with $t \in (n, \dots, N-H)$ and $h \in (1, \dots, H)$ and returns a multi-step forecast by concatenating the H predictions. Since the Direct strategy does not use any approximated values to compute the

forecasts. First, since the H models are learned independently no statistical dependencies between the predictions is considered. Second direct methods often require higher functional complexity (Tong,1983) than iterated ones in order to model the stochastic dependency between two series values at two distant instants (Guo, 1999). Last but not least, this strategy demands a large computational time since the number of models to learn is equal to the size of the horizon.

RESULTS

As was with the RF model and the XGBoost model, the ANN model LSTM utilized the same data. In the case of artificial neural networks, the approach use stacked hidden layers, and depending on the Epoch, the data results may vary.

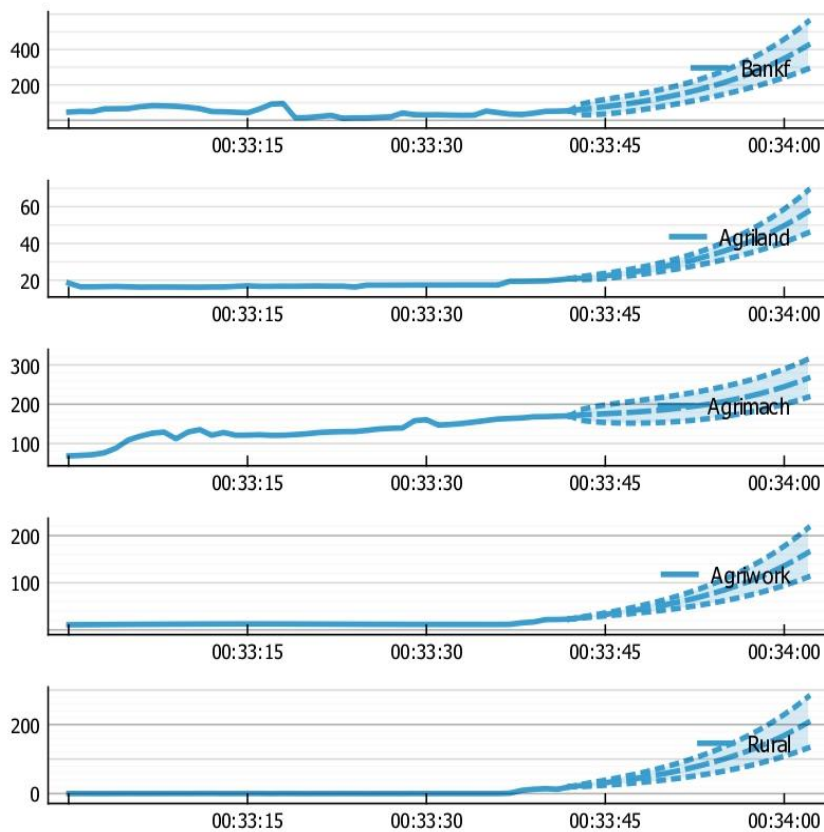
In order to analyze the earlier data, the LSTM model used the Keras deep learning library from the Python language. Furthermore, the LSTM uses the Keras deep learning library with a default activation function that outputs a value between -1 and 1 via the hyperbolic tangent function. As such, by using the min max scaler, the input values are similarly changed to a measure between -1 and 1. The behavior of the LSTM model can change depending on the optimizer and activation function used.

As such, since tuning the parameters affects the resulting value, suitable values for the parameters were obtained through a grid search approach within a set boundary while the overall structure remained fixed.

In this research, the ReLU activation was used as it was, proven to be the most effective. Furthermore, in order to reduce overfitting and improve the performance of the model, the dropout and recurrent dropout settings were each set to 0.1. The epochs were set to 100, with an early stopping function with a patience setting of 10 put in place in order to make sure the loss function output did not increase during the training.

Next, setting the number of units as 8, 16, 32, the learning rate as 0.01, 0.05, 0.1, and batch size as 16, 32, 48 as variables, all possible combinations were attempted. The result of which was that out of the 26 possible combinations, for Period 1, when the parameters were unit 16, learning 0.001, batch size 16, the RMSE was minimized, and for Period 2, when the parameters were unit 16, learning rate 0.05, batch size 32, the RMSE was similarly minimized. The selected parameters were used to build the model for each time period. Figure 3 is a graph comparing actual and expected values of agricultural growth outcomes.

Figure 3. Var forecasting



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The results of predicting the values of the time series inputs showed an increase in all variables of agricultural reforms, including the agricultural labor variable, which gave positive results to increase agricultural growth rates for the coming years for Algeria, starting from the year 2023.

CONCLUSION

Accurate forecasting of the total agricultural growth rate is crucial in the framework of agricultural reform policy. As Algeria has become highly dependent on the shift in the use of new exports outside the hydrocarbon sector, and when the rate of agricultural reform policies is increasing at an effective pace, accurate forecasting of the rate of agricultural growth is important. This is because, through this, problems related to the agricultural sector can be addressed effectively along with planning for the stable growth of the economy

The development of the contribution of the agricultural product to the GDP fluctuated between increase and decrease, and the lowest value of the contribution of the agricultural sector was during the years (1982, 1983, 1984) by Contribution estimated at: (5.96%, 5.28%, 5.21%), respectively.

As for the highest levels of this contribution, it was in the years (1989, 1992, 2001, 2003, 2016) with an estimated contribution of: (9.60%, 9.45%, 9.67%, 9.78%, 12.29%). However, despite these increases, especially in the recent period, the contribution of the agricultural sector to the gross domestic product remains far from the same. What is expected of it as a promising sector that possesses the qualifications that enables it to play a good role in the Algerian economy, especially in light of the risks Oil sector revenues declined.

The results of estimating the long-term relationship showed that agricultural bank financing has a positive effect on agricultural growth, which means that agricultural bank financing has a significant effect on the change in agricultural growth rates in Algeria over the long term.

Agricultural mechanization has a positive and significant effect on agricultural growth, which means that an increase in agricultural mechanization by one unit (a tractor and an agricultural machine per 100 km²) leads to an increase in agricultural growth in Algeria by 0.21% by 1.3%.

Agricultural lands have a positive and significant effect on agricultural growth, which means that agricultural lands have an influence on the change in agricultural growth rates in Algeria in the long term.

Agricultural labor has a positive and significant impact on agricultural growth, which means that an increase in employment by one million people leads to an increase in agricultural growth in Algeria by 12% over the long term.

We note, based on the results of long-term expectations, that the new agricultural reforms have an effective impact on agricultural growth beyond the year 2022, which leads to an increase in employment rates, all of which is reflected in the economic growth of Algeria in the future.

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Author Contributions: Hassiba.H: Conceptualization, Methodology, Data Curation, Software, Writing-Original Draft Preparation, Writing Reviewing, and Editing.

Hassiba.H: Conceptualization, Methodology, Writing Reviewing, and Editing.

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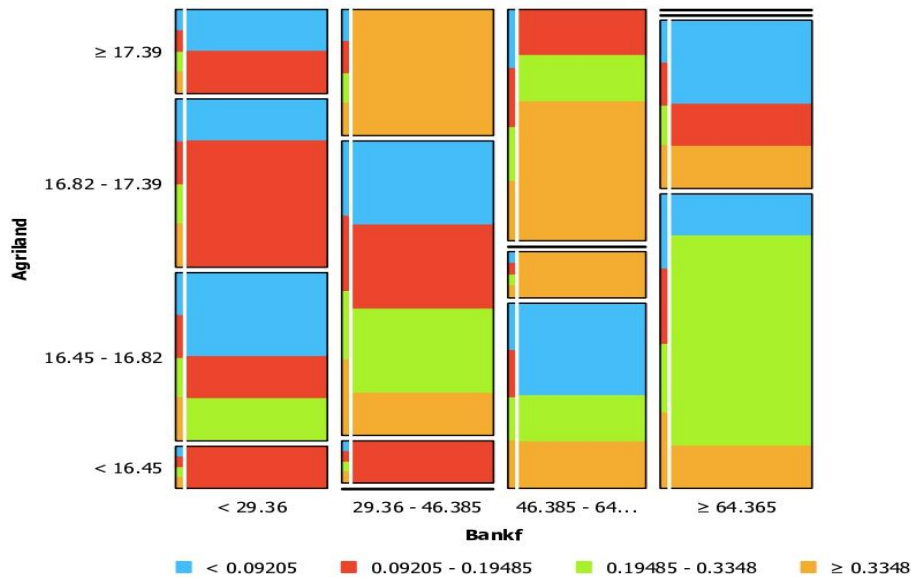
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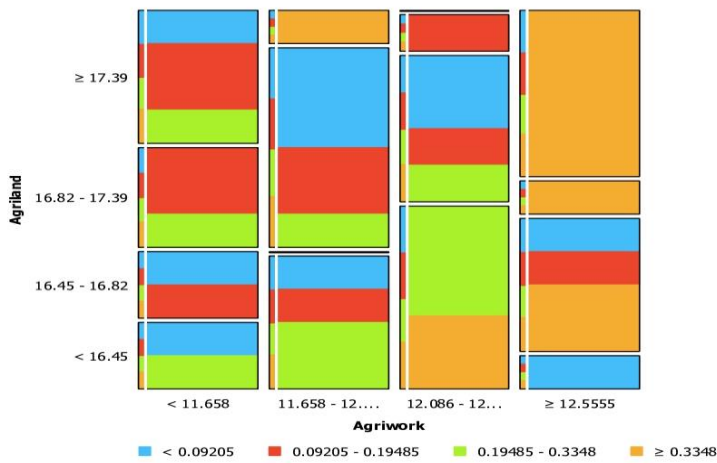
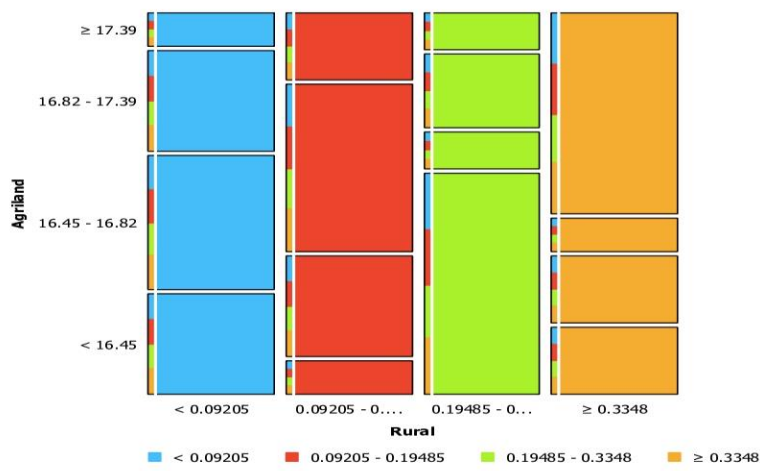
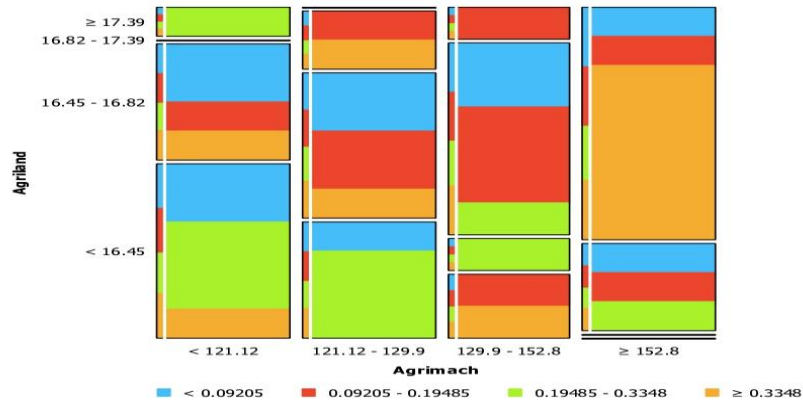
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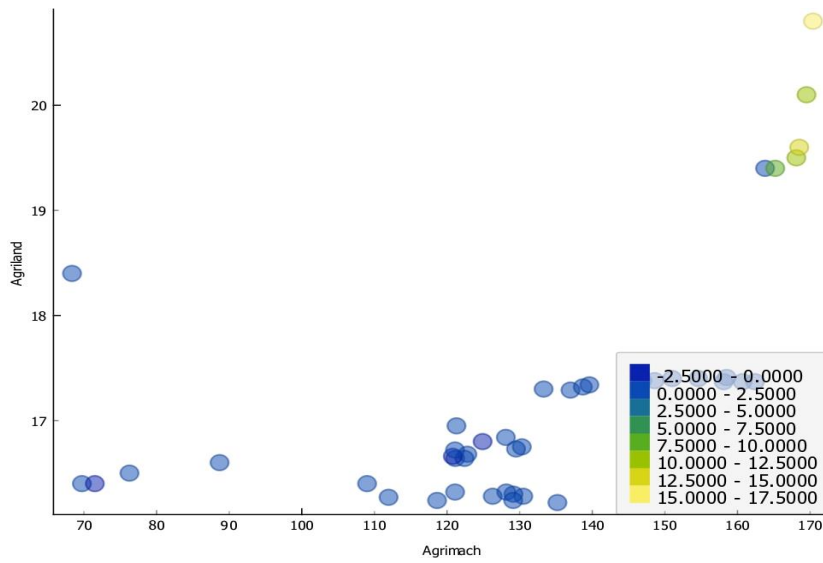
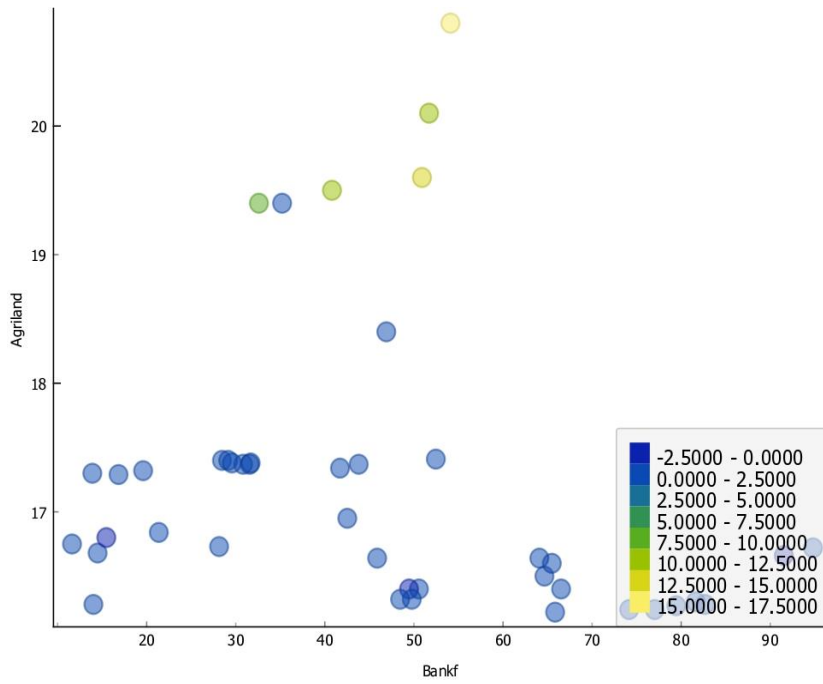
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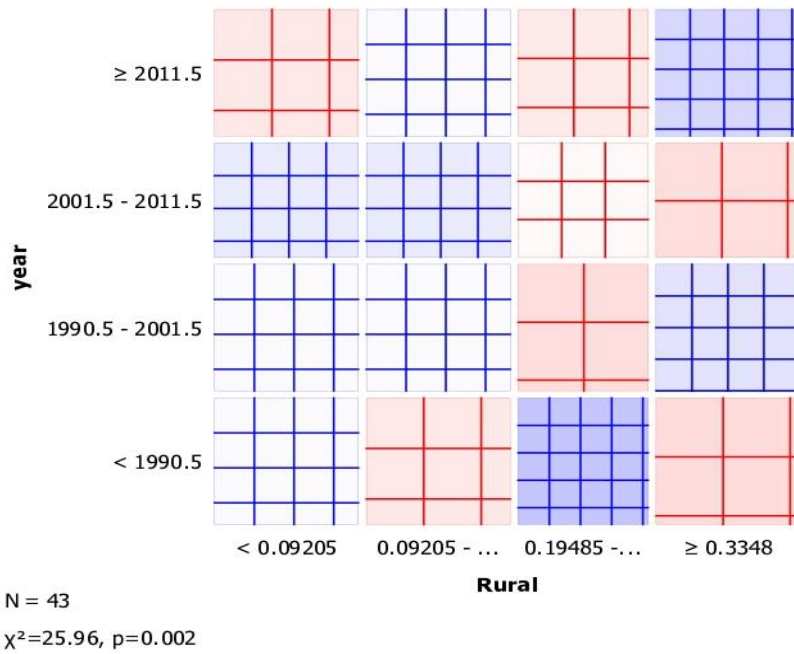
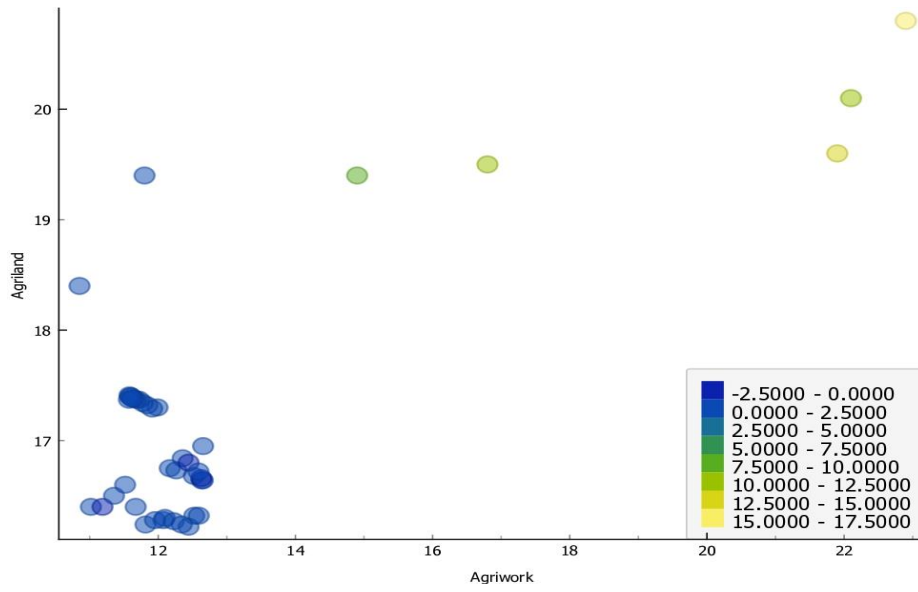
Appendix 1. Forms of agrarian reform inputs and agricultural growth



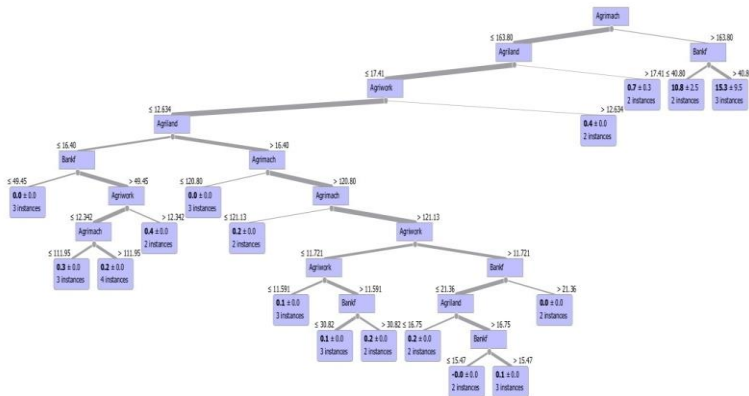
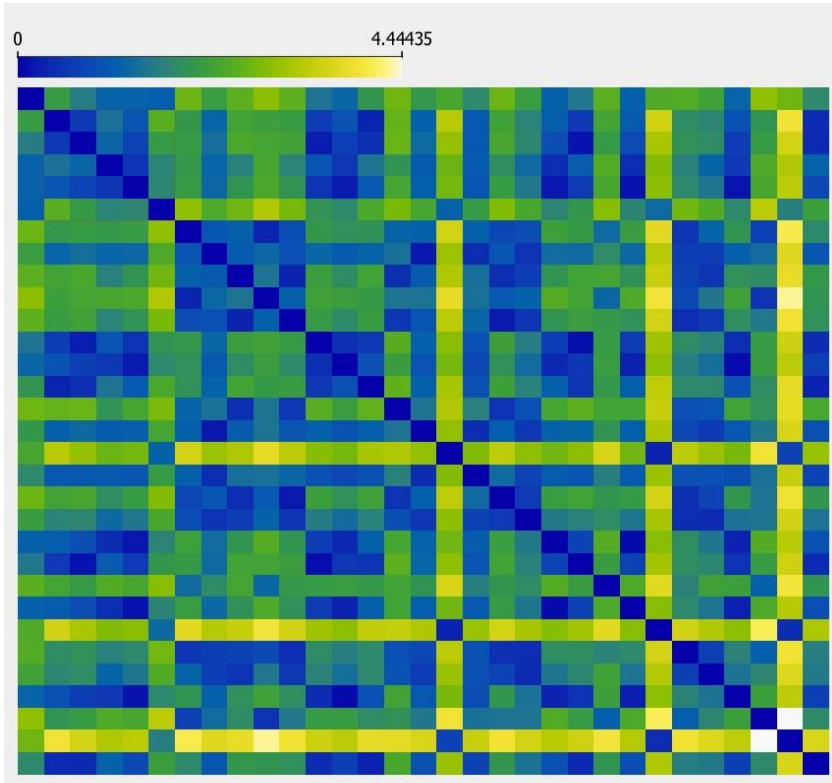


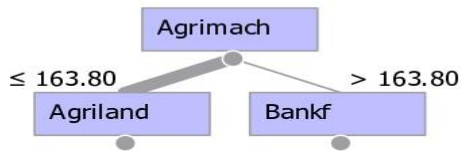
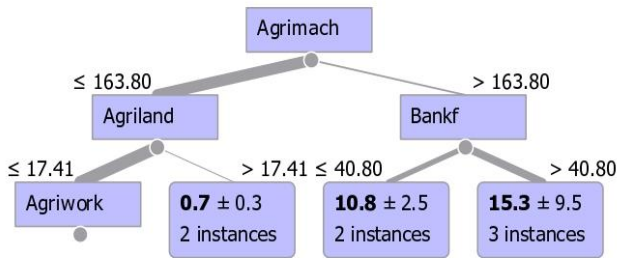
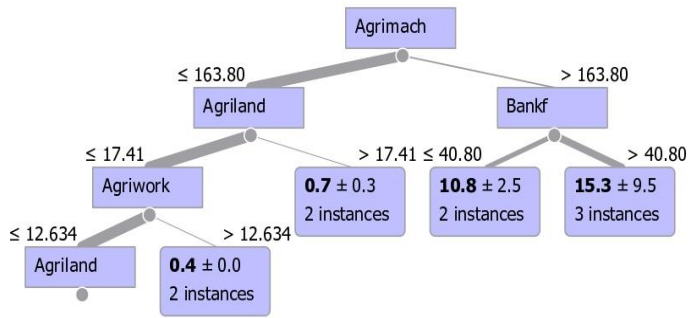
Hadouga. H: Prediction Of Agricultural Growth Rate As A Result Of Agricultural Reforms



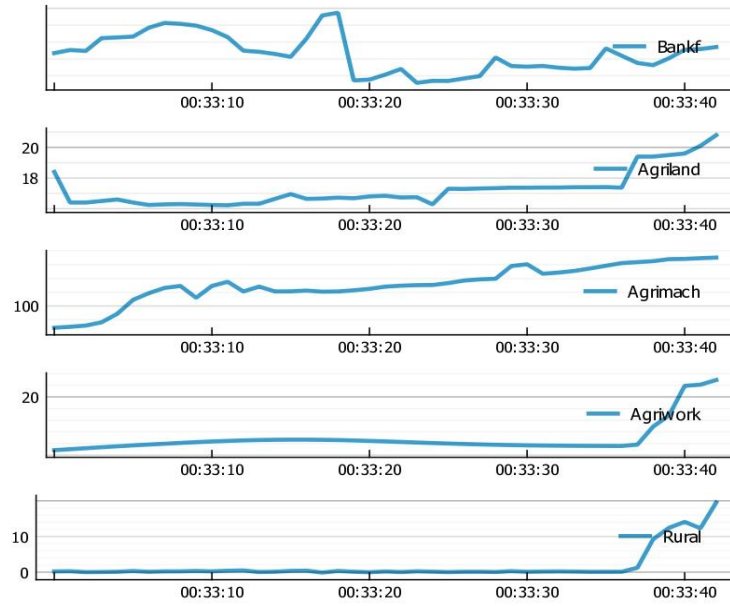


Hadouga, H: Prediction Of Agricultural Growth Rate As A Result Of Agricultural Reforms

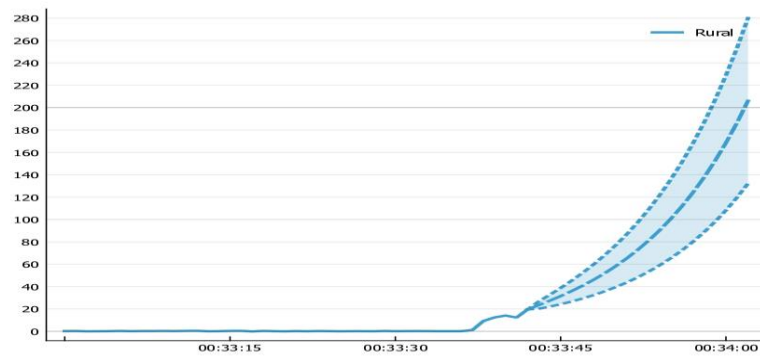
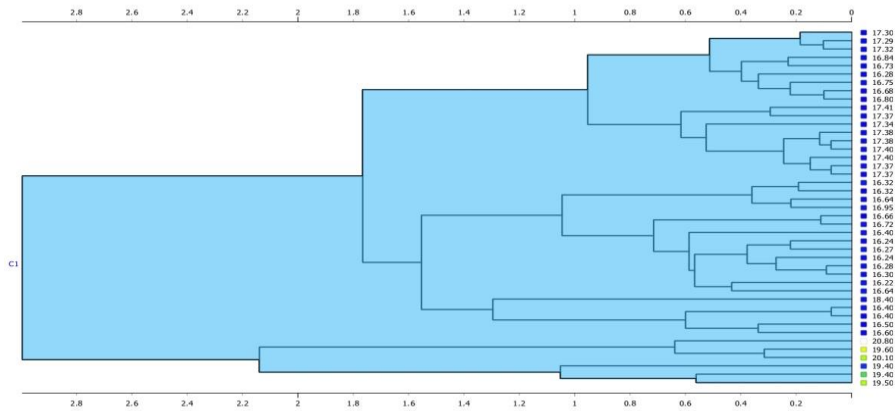




Hadouga. H: Prediction Of Agricultural Growth Rate As A Result Of Agricultural Reforms



Appendix 2. Forms of predictive study outcomes



Data instances: 20
 Features: 15
 Meta attributes: None

	Rural (forecast)	Bankf (forecast)	Agriland (forecast)	Agrimach (forecast)	Agriwork (forecast)	Rural (95%CI low)	Bankf (95%CI low)	Agriland (95%CI low)	Agrimach (95%CI low)	Agriwork (95%CI low)	Rural (95%CI high)	Bankf (95%CI high)	Agriland (95%CI high)	Agrimach (95%CI high)	Agriwork (95%CI high)
2023	23.379	61.9346	21.1221	172.688	26.2482	20.1633	31.9377	20.2635	158.812	25.125	26.5947	91.9314	21.9807	186.564	27.3713
2024	27.3238	69.4235	21.655	174.364	29.4899	22.0735	32.0323	20.5045	155.494	27.5118	32.5742	106.815	22.8054	193.234	31.468
2025	31.4954	77.2491	22.3402	175.844	32.7888	24.2364	36.1833	20.9692	153.504	29.6799	38.7544	118.315	23.7111	198.184	35.8976
2026	35.9779	85.7695	23.148	177.371	36.254	26.6554	42.5568	21.5811	152.345	31.8392	45.3003	128.982	24.7149	202.396	40.6687
2027	40.839	95.1789	24.0659	179.09	39.9636	29.3605	50.4749	22.3061	151.866	34.1082	52.3175	139.883	25.8257	206.314	45.8189
2028	46.1385	105.595	25.0911	181.094	43.9787	32.3827	59.6071	23.1257	152.001	36.5551	59.8944	151.584	27.0566	210.187	51.4022
2029	51.9337	117.108	26.2274	183.443	48.3516	35.7535	69.7623	24.03	152.715	39.2259	68.1139	164.454	28.4247	214.17	57.4773
2030	58.2823	129.8	27.482	186.183	53.1315	39.5061	80.8183	25.0151	153.991	42.1576	77.0585	178.782	29.9489	218.375	64.1054
2031	65.245	143.764	28.8653	189.354	58.3672	43.6763	92.6969	26.081	155.824	45.384	86.8137	194.831	31.6496	222.884	71.3504
2032	72.8869	159.104	30.3894	192.995	64.1095	48.304	105.356	27.2315	158.219	48.9389	97.4697	212.853	33.5473	227.771	79.2801
2033	81.2785	175.943	32.0683	197.145	70.4126	53.4332	118.791	28.4731	161.188	52.858	109.124	233.094	35.6634	233.103	87.9672
2034	90.497	194.417	33.9176	201.848	77.3351	59.1125	133.035	29.8149	164.749	57.1798	121.882	255.799	38.0202	238.946	97.4905
2035	100.627	214.686	35.9544	207.15	84.9409	65.396	148.159	31.2676	168.926	61.9461	135.858	281.213	40.6413	245.373	107.936
2036	111.76	236.926	38.198	213.103	93.3	72.3433	164.267	32.8439	173.747	67.2029	151.178	309.585	43.5522	252.46	119.397
2037	124	261.334	40.6692	219.768	102.489	80.0203	181.495	34.5578	179.241	73.0005	167.98	341.173	46.7805	260.294	131.978
2038	137.457	288.129	43.3909	227.207	112.592	88.4995	200.005	36.4251	185.442	79.3941	186.415	376.252	50.3568	268.972	145.79
2039	152.256	317.553	46.3886	235.492	123.702	97.8608	219.98	38.4628	192.383	86.4445	206.651	415.126	54.3144	278.602	160.96
2040	168.53	349.873	49.69	244.704	135.922	108.192	241.621	40.6898	200.1	94.2184	228.869	458.125	58.6903	289.308	177.625
2041	186.431	385.384	53.3258	254.93	149.361	119.591	265.149	43.1266	208.632	102.789	253.271	505.619	63.525	301.228	195.934
2042	206.121	424.409	57.3296	266.268	164.146	132.163	290.8	45.7958	218.016	112.237	280.078	558.018	68.8634	314.519	216.054