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# Assessing Effectiveness of Agricultural Support Policy against its Actual Effects on Farm Prices & Farm Loan Rate and Supply-demand Parameters: A Study of Rice Farming in USA

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**Abstract**

The burgeoning population, increased affordability, and consumption, scaled up agriculture in order to bridge the gap between demand and supply particularly from agriculture and livestock, and food security issue arising out of an exponential increase in food demand and consumption till 2050 as forecast by FAO has generated quite a few areas of focus in terms of appropriate policy measures, controls, policy communications and achieving the desired response and performance from farmers, markets, financial support agencies that meet the national objectives and targets in the most efficient and environmentally friendly manner. This research illustrates a possible direction to examine the interrelationship of agricultural operations, markets, prices and policy control variables in terms of support price and financial support to farmers. It also offers an insight into how each policy variable may shape the outcome of different parameters more intertwined to it.

**Keywords:** agri-economics, farm law, agricultural policy, agricultural marketing assistance, econometrics

## 1. Introduction

Historically there was a point in 1994 when D. Calverley and Agricultural Experts & Practitioners across various countries discussed and worked out commonalities proposed in a comprehensive summary table which not only ignored distinctions between countries, methods, implements or machines, seasons, places, and times taken, but takes

all post-harvest activities and lumped them together into five main operations in order to reach a common, general average or rather two averages, one by simple arithmetical addition and the other by "cumulative" addition.

The validity of such simplistic calculations was open to doubt, for the somewhat theoretical results depend on "deductions", as the author himself calls them. Their value lied more in their contribution to knowledge of trends or their scale and in establishing indispensable statistics. This study was therefore useful, for it gives averages (in percentages), which can be compared with the results of similar surveys and studies across countries.

The above mentioned effort was more on the study and comparison across countries of agricultural practices, resultant yields, and other operational parameters.

The recent global trends have shown a shift from Subsistence Crops (defined in this context as people – not necessarily farmers – who worked the land did so to support and feed their own families and livestock, growing just to make ends meet) to Cash Crops (crops grown with profit maximization from market as the foremost objective). For many years a crop was classified as Subsistence if grown in underdeveloped regions/economies and mainly in the economies with no, little, or marginal economic surpluses and/or marginal employment. Similarly the exclusive crops or exclusive variety of a crop that fetched abnormal profits compared to regular agricultural produce were classified as Cash Crops. With ever increasing varieties and variants of Agricultural Produce, primarily due to Agricultural Research focusing on improving productivity & yield and maximizing profits on a crop, most newly discovered crop variants and agricultural innovations are creating a market shift and mindset change in farmers and market alike to treat more & more crops as Cash Crops.

This trend has shifted the outlook to Farmer–Market interaction, Farm Price finalization mechanism, Agricultural Policy control & administration, intent & direction of the Policies themselves and policies & actions related to agricultural support – both technological and financial.

## 2. Literature Review

Meeting the food demand of a rapidly increasing global population is emerging as a big challenge to mankind. The population is expected to grow to 9.1 billion people by the year 2050, and about 70% extra food production will be required to feed them.[1,2,3] Most of this population rise is expected to be attributed to developing countries, several of which are already facing issues of inadequate supply, and food insecurity. Increasing urbanization, climate change, and land use for non-food crop production, intensify these concerns of increasing food demands. In the last few decades, most of the countries have focused on improving their agricultural production, land use, and population control as their policies to cope with this increasing food demand.

Agriculture is a key activity of human being since it provides basic needs such as food, clothing, and shelter. It has been demonstrated that every 1% increase in agricultural yield translates into a 0.6–1.2% decrease in the numbers of absolute poor households in the

world.[1] Meanwhile, population growth was predicted to be 9.7 billion by 2050 and this will require an increase of about 70% in food production to meet the demand.[2]

## 2.1. Harvesting as the Decisive Operation for Marketable Grains

Harvesting is the first step in the grain supply chain and is a critical operation in deciding the overall crop quality. In the developing countries, crop harvesting is performed mainly manually using hand cutting tools such as sickle, knife, scythe, cutters. Almost all of the crop is harvested using combine harvesters in the developed countries.

Harvesting timing and method (mechanical vs. manual) are two critical factors dictating the losses during the harvesting operations. A large amount of losses occurs before or during the harvesting operations, if it is not performed at adequate crop maturity and moisture content. Too early harvesting of crop at high moisture content increases the drying cost, making it susceptible to mold growth, insect infestation, and resulting in a high amount of broken grains and low milling yields.[4] However, leaving the matured crop un-harvested results in high shattering losses, exposure to birds and rodents attack, and losses due to natural calamities (rain, hailstorms etc.)[5]The time of harvesting is determined by the degree of maturity. With cereals and pulses, a distinction should be made between maturity of stalks (straw), ears, or seedpods and seeds, for all that affects successive operations, particularly storage and preservation.[6]

## 2.2. Rice – the Crop and its Value Chain across World

Many of the available works in loss assessment, based on field surveys, are devoted to rice-growing and its post-harvest system. D. Calverley's regional assessment (1994), covering several countries in central and south-eastern Asia, is a good example and gives an idea of the complexity of a summary and/or comparative evaluation, whether one or more products are being considered. Since rice holds pride of place, in this study we have concentrated on this basic grain with limited avenues for value addition through further processing, so that comparison will focus mainly on operations, farm price, financial support available to farmer and the supply-demand metrics in quantity terms. Furthermore, this study is confined to results connected with Policy Impact on Rice production (i.e. post-harvest), supplies to market, buffer stocks – further leading to the assessment of planned Policy Intent versus actual Performance Indicators (numerical objectives) arrived through mathematical analysis of data and further application of intuitive & deductive logic.

United Nations' Food and Agriculture Organization (FAO), listed the most valuable agricultural products produced by the countries of the world.[1] The value and production of individual crops varies substantially from year to year as prices fluctuate on the world and country markets and weather and other factors influence production.

This list included the top 50 most valuable crops products but does not necessarily include the top 50 most heavily produced crops. Rice figures on top of the list:

| Crop | Global gross production value in billion US$ | Global production in metric tons |
|---|---|---|
| Rice, paddy | $332 | 751,885,117 |

India is also the world second-largest producer of rice, wheat, sugarcane, fruit, vegetables, cotton, and groundnuts.[7]

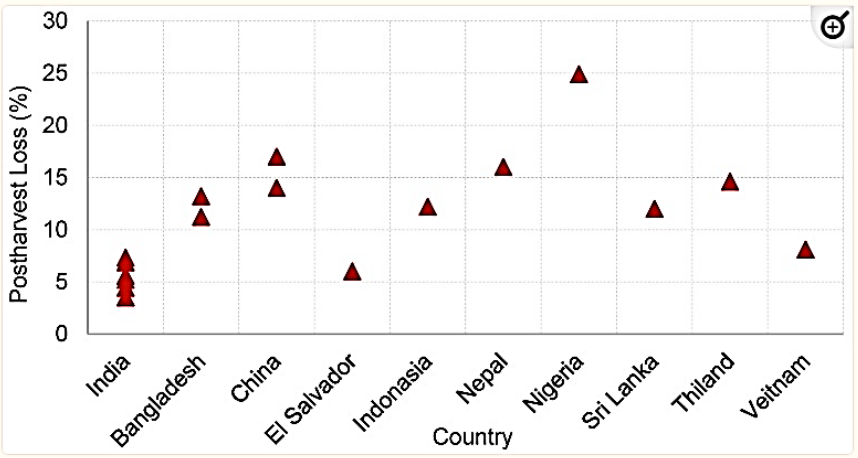


Figure 2

Postharvest losses in the rice value chain in various countries (in the case of a range of losses, an average of losses was used).

Ref: [1,2,3]

Despite achieving self-sufficiency in grain production, India still remains quite reliant on subsistence agriculture as by far the poorest country on this list on a per capita basis.[8][9]This has dictated the inefficient use of limited resources, particularly water, leaving output dependent on seasonal monsoons and crop yields below the global average.

Despite such obstacles, India remains the world's largest exporter of refined sugar and milled rice. Strong exports of rice, cotton, soybeans, and meat helped India move up to 9th place among global agricultural exporters in 2019.[10][11]

## 2.3. Cash Crops versus Subsistence Crops

A noteworthy current trend is to develop cash crops as a staple in the agricultural economy across the nation, regardless of geography. Cash crops, or crops grown and sold for profit, are a vital part of the American farmer's livelihood. Before this shift to a cash crop economy, most people who worked the land grew what is referred to as subsistence crops. It was not uncommon for smaller family farms to plant and harvest just enough food to feed their family. Many farmers would sell the remaining commodities at a local market if their harvest produced a higher-than-expected yield. However, as the global population and food demand grew, many smaller farms began to focus on profitable cash crops. Today, the agriculture industry is heavily supported by cash crop farming.

## 2.4. Ripple Effect of Growing Cash Crops

There are many benefits to growing cash crops beyond the most obvious one, which is making money. Growing and selling crops for profit can affect local, national, and global economies. They are a crucial contributor to food security in third-world countries and rural American communities. The benefit of cash crops is the ripple effect they have within communities. Higher produce and commodity yields generate more jobs, leading to more people seeking skilled trades or professions – ultimately progressing the economy further. In addition, profits from growing cash crops often re-enter the economy as farmers patronize other businesses, thus contributing to the success of local commerce.

## 2.5. Tried and Tested: Traditional Cash Crops

Through the years, several profitable cash crops have become high-yielding farmer favorites – Rice, maize/corn, wheat, and soybeans. On a global scale, rice, maize, and wheat are the most valuable earners. In America, soybeans and corn are at the top of the pack, bringing in nearly $120 billion in 2021 mostly on account of value added products and in case of maize/corn on account of ethanol based fuels.

## 2.6. Agricultural Subsidies–USA

Agricultural subsidies are monetary payments and other types of support given by the government to farmers and agribusinesses. Some subsidies are intended to protect producers from market instability, while others are designed to incentivize certain production practices or influence market behavior. Subsidies are calculated and dispersed differently across government programs. Currently, five commodity crops are particularly heavily subsidized by the US government—corn, soybeans, wheat, cotton, and rice. Other programs exist for sugar and dairy farmers.

The US government's first Agricultural Adjustment Act (AAA) was passed in 1933, part of Franklin D. Roosevelt's New Deal program aimed at restructuring the US economy. The 1933 AAA paid farmers to stop producing certain commodities to reduce crop surpluses, increase prices, and safeguard farm incomes during the Great Depression.[12] Wheat, cotton, corn, rice, tobacco, and milk were covered in the initial act.[13]

## 2.7. Agricultural Risk Coverage (ARC)

Agricultural Risk Coverage (ARC),[14] another USDA program, covers many row crops, including barley, soybeans, peanuts, rice, oats, corn, wheat, and chickpeas. ARC pays farmers when their crop revenues fall below a guaranteed level.

## 2.8. Price Loss Coverage (PLC)

Price Loss Coverage (PLC)[14] covers the same commodity crops as ARC. However, PLC pays farmers when the effective price of a given product falls below the national

marketing-year average price or the national average loan rate. Farmers who grow crops covered by ARC and PLC must elect to use one or the other.

## 2.9. Counter-Cyclical Payments (CCPs)

The Counter-Cyclical Payments (CCPs) program was a government payment based on the prices for specific crops. Like the direct payment system, CCPs formulas were based on historical data[15] and not current production data. So, "if a farmer's land was producing cotton at the time when the base acreage was calculated, the current owner will get a cotton CCP regardless of what he is or is not growing currently." The 18 crops [16] for which direct and counter-cyclical payments were made were: barley, corn, grain sorghum, oats, canola, crambe, flax, mustard, rapeseed, safflower, sesame, sunflower, peanuts, rice (not wild rice), soybeans, cotton, and wheat. These crops are known as commodity crops. Both direct and counter-cyclical payments were established in the 2002 farm bill and administered by the USDA's Farm Service Agency. *CCPs were replaced with a new system* [17] *of counter-cyclical payment for farmers when crop prices fall below certain levels, made up of Agriculture Risk Coverage (ARC) and Price Loss Coverage (PLC) payments, in the 2014 farm bill.*

**What It Is:** Income support that is provided when a covered commodity's marketing year average price plus the direct payment rate is less than its specified target price. Under this policy tool, payments are decoupled from production. Like direct payments, payments are based on historical program production (payment acres multiplied by CCP payment yields). CCP payments do depend on price levels, so payments are not decoupled from price. This program was initiated in the 2002 farm bill as a result of chronically low prices during the late 1990s and early 2000s that prompted Congress to provide market loss assistance payments. Supporters of this type of program cite that payments are truly counter-cyclical, as government support is only received when prices are low while support declines as prices rise. Prices above specified levels result in no government support from this policy tool.

**Objective:** To provide income support that is counter-cyclical with regard to market prices.

**When Used:** CCPs were authorized in the 2002 farm bill through 2007. Significant CCP payments were made due to low prices during the early to mid-2000s. As commodity prices increased near the end of its authority, very few CCP payments were made to commodities other than cotton.

**Consequences:**

- Provides for income support that is partially decoupled. That is, decoupled from actual production but not prices.
- Some commodities felt that the level of their target price was set too low to provide much of a safety net.
- Provides for income support in the event of low prices for covered commodities.

- Lenders could not typically use CCPs as part of a producer's repayment capacity due to counter-cyclical nature.

## 2.10. Average Crop Revenue Election Program (ACRE)

Federal lawmakers created the **ACRE program**[18] as part of the 2008 farm bill. It paid farmers a minimum revenue, whether losses were due to low prices, poor weather, or other circumstances, and limited these farmers' access to other subsidies.

US legislators ended this limited program with the 2014 farm bill and replaced it with the **Agriculture Risk Coverage program**,**[19]** which pays farmers "when actual crop revenue declines below a specified guaranteed level." The ARC and PLC programs are eligible to producers of 22 crops, including dry peas, lentils, chickpeas, and temperate japonica rice.

## 2.11. Who Benefits Most From Farm Subsidies?

The richest farmers and agribusinesses producing corn, soybeans, wheat, cotton, and rice **benefit the most**[20] from farm subsidies. In 2019, the wealthiest 1% of farm operations **received**[21] nearly one-quarter of the USDA's total subsidies. The richest 10% received nearly two-thirds. Meanwhile, nearly a third of all the corn grown in America is purchased by Cargill and ADM, as Michael Pollan points out in "The Omnivore's Dilemma."

Farm subsidies do not account for the economic needs of rural farmworkers.**[22]** According to the Cato Institute, "the vast majority of aid goes to the capital-intensive production of field crops such as corn, soybeans, and wheat."

In his analysis on Agricultural Subsidies (16 April 2018), Chris Edwards analyzed that the federal government spends more than $20 billion a year on subsidies for farm businesses. About 39% of the nation's 2.1 million farms receive subsidies, with the lion's share of the handouts going to the largest producers of corn, soybeans, wheat, cotton, and rice.[22]

To quote, "The government protects farmers against fluctuations in prices, revenues, and yields. It subsidizes their conservation efforts, insurance coverage, marketing, export sales, research, and other activities. Federal aid for crop farmers is deep and comprehensive."

However, agriculture is no riskier than many other industries, and it does not need an array of federal subsidies. Farm subsidies are costly to taxpayers, but they also harm the economy and the environment. Subsidies discourage farmers from innovating, cutting costs, diversifying their land use, and taking other actions needed to prosper in the competitive economy."

## 2.11. Marketing and Regulatory Programmes

### 2.11.1. Mission

The Marketing and Regulatory Programs (MRP) mission is to facilitate and expand the domestic and international marketing of US agricultural products, to help protect the

agricultural sector from animal and plant health threats, and to ensure humane care and treatment of regulated animals. These programs provide the basic infrastructure to improve agricultural market competitiveness for the overall benefit of consumers and producers of American agriculture. US agricultural exports totaled $146 billion in 2020, supported by MRP and other mission areas in USDA.

To meet demand for American grain and to ensure consistent grain quality, MRP is providing service at export facilities 24 h a day. MRP also assists producers in management and domestic marketing by providing market trend analysis and business and marketing tools. MRP also helps increase the competitiveness of the agricultural sector by working to protect the Nation's agriculture from pests and diseases, thereby increasing the efficiency of production.

### *2.11.1.1. Transportation and Market Development*

The Budget requests $9.855 million for Transportation and Market Development, which conducts research and outreach related to grain shipping and supply chains. The program connects agricultural producers with high value market opportunities through its national market directories.

*Table FPAC-2. CCC Payments by Commodity (millions of dollars)*

| Item | 2021 Actual | 2022 Estimate | 2023 Budget |
|---|---|---|---|
| Commodity: | | | |
| Feed Grains | $3,125 | $1,436 | $1,410 |
| Wheat | 1,348 | 1,103 | 162 |
| Rice | 686 | 478 | 506 |
| Extra Long Staple Cotton | 137 | 87 | 145 |
| Upland Cotton | 2,179 | 1,723 | 2,125 |
| Seed Cotton | 955 | 582 | 24 |
| Lentils | 18 | 14 | 4 |
| Honey | 4 | 6 | 5 |
| Dairy and Products | 781 | 1,656 | 1,064 |
| Soybeans | 1,192 | 794 | 1,226 |
| Other Oilseeds | 123 | 51 | 21 |
| Sugar | 1,050 | 1,087 | 1,131 |
| Peanuts | 1,293 | 1,327 | 1,268 |
| Soybeans Products | 8 | 3 | 3 |
| Other Commodities | 51 | 49 | 43 |
| Total, Commodity Payments | 13,482 | 10,326 | 9,118 |

*Includes Marketing Assistance Loans, however, doesn't reflect loan repayments

Source: USDA FY 2023 Budget Summary

Therefore, on account of it being a highest revenue earning crop on account of quantity produced and yet receiving substantive subsidies, farmer revenue & cyclical protection and marketing/logistics assistance – the US Agricultural Policy in terms of price regulation, using farm loan interest as a policy tool, and creation of just adequate buffer from inflation control & food security perspectives bears some examination.

## 3. Research Methodology

The Farm Bill revisions and amendments typically happen in a yearly cycle – hence the data has been acquired and studies for the period 2010–2023 (Accounting Years). The data used is in nature of complete enumerations and finalized typically after 3 successive refinements of comprehensive surveys for each year. Further, using regression and correlation tools on significant variables of Agricultural & Market Performance in each year an attempt has been made to understand the strong links at high significance levels between these variables:

1) Operational Variables:
   a. Total use/disposition stocks (buffer stocks)
   b. Quantity Imported
   c. Quantity Exported
   d. Production
   e. Domestic Use and
   f. Supply Total
2) Policy control/ target variables:
   a. Farm Price to Market
   b. Farm Loan Rate.

An iterative regression and correlation analysis has been done to understand the regression coefficients as well as the strength of correlation. The two Policy Variables were also switched as dependent and independent to illustrate the extent dependency on Farm Price on Farm Loan Rate and vice versa.

## 4. Complete Population Data and Policy Targets on Rice Agriculture Finalized by USDA used for Analysis

*Agricultural outcomes and farm prices for rice in USA 2010–2023 YTD AND forecast upto 2033.*

| Commodity | Year | Domestic Use Mn cwt | Production Mn cwt | Farm Price in US$ per cwt | Supply Total in Mn cwt | Loan Rate US$ per cwt | Exports in Mn cwt | Imports in Mn cwt | Total use/ disposition Mn cwt | Variable cost of Production per cwt US$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 2010/11 | 137.8 | 243.1 | 12.7 | 297.9 | 6.5 | 111.6 | 18.3 | 249.5 | 7 |
| Rice | 2011/12 | 110.2 | 185 | 14.3 | 252.8 | 6.5 | 101.6 | 19.4 | 211.8 | 8 |
| Rice | 2012/13 | 118.1 | 199.5 | 14.87 | 261.6 | 6.5 | 107.1 | 21.1 | 225.2 | 8 |
| Rice | 2013/14 | 124.9 | 189.9 | 16.1 | 249.4 | 6.5 | 92.7 | 23.1 | 217.6 | 8 |
| Rice | 2014/15 | 128.7 | 221 | 13.3 | 277.5 | 6.5 | 100.3 | 24.7 | 229 | 8 |
| Rice | 2015/16 | 110.8 | 192.3 | 12.1 | 265 | 6.5 | 107.7 | 24.1 | 218.5 | 8 |
| Rice | 2016/17 | 131.4 | 224.1 | 10.4 | 294.1 | 6.5 | 116.7 | 23.5 | 248 | 8 |
| Rice | 2017/18 | 134.8 | 178.2 | 12.6 | 251.2 | 6.5 | 87 | 26.9 | 221.8 | 8 |
| Rice | 2018/19 | 144.1 | 224.2 | 12 | 282.6 | 6.5 | 93.6 | 29 | 237.7 | 7 |
| Rice | 2019/20 | 144.0 | 184.7 | 13.2 | 266.8 | 7 | 94.2 | 37.3 | 238.2 | 7 |
| Rice | 2020/21 | 152.7 | 227.6 | 13.7 | 290.3 | 7 | 93.9 | 34.1 | 246.6 | 7 |
| Rice | 2021/22 | 151.4 | 191.8 | 15.7 | 273.2 | 7 | 82.2 | 37.8 | 233.5 | 8 |
| Rice | 2022/23 | 141.0 | 165.4 | 19.4 | 249.2 | 7 | 75 | 44 | 216 | 10 |
| Rice | 2023/24 | 149.0 | 186.7 | 18.1 | 262.4 | 7 | 78 | 42.5 | 227 | 9 |
| Rice | 2024/25 | 151.0 | 191.3 | 17.1 | 269.4 | 7 | 81 | 42.8 | 232 | 9 |
| Rice | 2025/26 | 153.5 | 193.9 | 16.5 | 273.8 | 7 | 83 | 42.5 | 236.5 | 9 |
| Rice | 2026/27 | 154.5 | 196.4 | 16.1 | 277 | 7 | 83.5 | 43.3 | 238 | 8 |
| Rice | 2027/28 | 156.5 | 196.8 | 15.7 | 280 | 7 | 84.5 | 44.3 | 241 | 8 |
| Rice | 2028/29 | 157.0 | 197.2 | 15.8 | 281.5 | 7 | 85 | 45.3 | 242 | 8 |
| Rice | 2029/30 | 158.0 | 197.5 | 15.8 | 283.2 | 7 | 85.5 | 46.3 | 243.5 | 8 |
| Rice | 2030/31 | 159.0 | 197.8 | 15.8 | 284.8 | 7 | 86 | 47.3 | 245 | 8 |
| Rice | 2031/32 | 160.0 | 198.2 | 15.9 | 286.2 | 7 | 86.5 | 48.3 | 246.5 | 9 |
| Rice | 2032/33 | 161.0 | 198.8 | 15.9 | 288.3 | 7 | 87 | 49.8 | 248 | 9 |
| | | | | | | | | | | |
| | Mean | 143.0 | 199.2 | 14.9 | 273.8 | 6.8 | 91.5 | 35.5 | 234.5 | 8.1 |
| | σ | 15.8 | 17.7 | 2.1 | 14.5 | 0.2 | 11.2 | 10.7 | 11.6 | 0.8 |
| | COV | 11% | 9% | 14% | 5% | 4% | 12% | 30% | 5% | 9% |

2023 estimates

# 5. Results with Analytics

## 5.1. Iteration 1

The first iteration of data in the Table appended on "AGRICULTURAL OUTCOMES AND FARM PRICES FOR RICE IN USA 2010-2023 YTD AND FORECAST UPTO 2033" was done considering Farm Prices for Rice in US$ per cwt as the Dependent Variable, and Total use/disposition Mn cwt, Imports in Mn cwt, Exports in Mn cwt, Production Mn cwt, Domestic Use Mn cwt, and Supply Total in Mn cwt as the six Independent Variables for the historical period up to 2023 as well as the USDA forecast up to and including 2032–2033. The purpose of using historical as well as the officially forecast data is to understand the underlying framework of forecast from 2023 to 2033 unified with the past data in terms of regression across various variables with the dependent variable in each iteration, its statistical significance, and the strength in terms of correlation coefficients.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.913[a] | 0.833 | 0.780 | 1.99580 |

[a]. Predictors: (Constant), Supply Total in Mn cwt, Imports in Mn cwt, Exports in Mn cwt, Production Mn cwt, Domestic Use Mn cwt, Total use/ disposition Mn cwt.

### 5.1.1. ANOVA[a]

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 377.049 | 6 | 62.842 | 15.777 | 0.000[b] |
| | Residual | 75.681 | 19 | 3.983 | | |
| | Total | 452.730 | 25 | | | |

[a]Dependent Variable: Farm Price in US$ per cwt.
[b]Predictors: (Constant), Supply Total in Mn cwt, Imports in Mn cwt, Exports in Mn cwt, Production Mn cwt, Domestic Use Mn cwt, Total use/ disposition Mn cwt.

## 5.2. Iteration 2

Based on the first iteration, the second iteration was selectively done for Linear Regression and Correlation considering Farm Prices for Rice in US$ per cwt as the Dependent Variable, and only Production in Mn cwt, Total use/ disposition Mn cwt, Supply Total in Mn cwtand Loan Rate in US$ per cwt as the five Independent Variables for the historical period up to 2023 as well as the USDA forecast up to and including 2032–2033. Results obtained were:

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.974[a] | 0.949 | 0.936 | 1.07468 |

[a]Predictors: (Constant), Loan Rate US$ per cwt, Imports in Mn cwt, Production Mn cwt, Total use/disposition Mn cwt, Supply Total in Mn cwt

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 429.632 | 5 | 85.926 | 74.400 | 0.000[b] |
| | Residual | 23.099 | 20 | 1.155 | | |
| | Total | 452.730 | 25 | | | |

[a]Dependent Variable: Farm Price in US$ per cwt.
[b]Predictors: (Constant), Loan Rate US$ per cwt, Imports in Mn cwt, Production Mn cwt, Total use/ disposition Mn cwt, Supply Total in Mn cwt.

| Correlations | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Farm Price in US$ per cwt | Total use/ disposition Mn cwt | Supply Total in Mn cwt | Imports in Mn cwt | Production Mn cwt | Loan Rate US$ per cwt |
| **Farm Price in US$ per cwt** | Pearson Correlation | 1 | 0.853** | 0.838** | 0.801** | 0.754** | 0.914** |
| | Sig. (2-tailed) | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | N | 26 | 26 | 26 | 26 | 26 | 26 |
| **Total use/ disposition Mn cwt** | Pearson Correlation | 0.853** | 1 | 0.998** | 0.674** | 0.970** | 0.986** |
| | Sig. (2-tailed) | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 |
| | N | 26 | 26 | 26 | 26 | 26 | 26 |
| **Supply Total in Mn cwt** | Pearson Correlation | 0.838** | 0.998** | 1 | 0.650** | 0.980** | 0.980** |
| | Sig. (2-tailed) | 0.000 | 0.000 | | 0.000 | 0.000 | 0.000 |
| | N | 26 | 26 | 26 | 26 | 26 | 26 |
| **Imports in Mn cwt** | Pearson Correlation | 0.801** | 0.674** | 0.650** | 1 | 0.515** | 0.715** |
| | Sig. (2-tailed) | 0.000 | 0.000 | 0.000 | | 0.007 | 0.000 |
| | N | 26 | 26 | 26 | 26 | 26 | 26 |
| **Production Mn cwt** | Pearson Correlation | 0.754** | 0.970** | 0.980** | 0.515** | 1 | 0.931** |
| | Sig. (2-tailed) | 0.000 | 0.000 | 0.000 | 0.007 | | 0.000 |
| | N | 26 | 26 | 26 | 26 | 26 | 26 |
| **Loan Rate US$ per cwt** | Pearson Correlation | 0.914** | 0.986** | 0.980** | 0.715** | 0.931** | 1 |
| | Sig. (2-tailed) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | |
| | N | 26 | 26 | 26 | 26 | 26 | 26 |

Correlation is significant at the 0.01 level (2-tailed).

This too yielded significant regression with Loan Rate, Total Use/disposition, and Imports as the three most significant and correlated factors to Farm Price.

## 5.3. Iteration 3

Based on the second iteration, the third iteration was selectively done for Linear Regression and Correlation considering Loan Rate for in US$ per cwt as the Dependent Variable, and only Production in Mn cwt, Total use/disposition Mn cwt, Domestic Use Mn cwt, Supply Total in Mn cwt, and Farm Price in US$ per cwt as the five Independent Variables for the historical period up to 2023 as well as the USDA forecast up to and including 2032–2033. Here the Loan Rate was switched in place of Farm Price as Dependent Variable, retaining Farm Price as one of the independent variable. Results obtained were:

| Model Summary | | | | |
|---|---|---|---|---|
| **Model** | **R** | **R Square** | **Adjusted R Square** | **Std. Error of the Estimate** |
| **1** | 0.996[a] | 0.992 | 0.990 | 0.17920 |

[a.] Predictors: (Constant), Farm Price in US$ per cwt, Supply Total in Mn cwt, Total use/ disposition Mn cwt.

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
| 1 | **Regression** | 82.604 | 3 | 27.535 | 857.488 | 0.000[b] |
| | **Residual** | 0.706 | 22 | 0.032 | | |
| | **Total** | 83.310 | 25 | | | |

[a.]Dependent Variable: Loan Rate US$ per cwt.
[b.]Predictors: (Constant), Farm Price in US$ per cwt, Supply Total in Mn cwt, Total use/disposition Mn cwt.

*This iterative model illustrates 99% of variation (adjusted R2 value) in dependent variable over the period studied (Loan Rate in US$ per cwt) explained by the three independent variables shortlisted after considering significances and strengths of correlations.*

*The highest and most significant correlation of Loan rate is with Total Use/ Disposition stock at 0.986. The Supply Total has high correlation of 0.980 but is not significant.*

| Coefficients[a] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **t*** | **Sig.** | **95.0% Confidence Interval for B** | | **Correlations** | | |
| | **B** | **Std. Error** | **Beta** | | | **Lower Bound** | **Upper Bound** | **Zero-order** | **Partial** | **Part** | |
| **1** | **(Constant)** | −0.045 | 0.131 | | −.347 | 0.732 | −0.316 | 0.226 | | | |
| | **Total use/ disposition Mn cwt** | 0.027 | 0.010 | 0.926 | 2.688 | 0.013 | 0.006 | 0.047 | 0.986 | 0.497 | 0.053 |
| | **Supply Total in Mn cwt** | −0.004 | 0.008 | −0.163 | −0.495 | 0.625 | −0.021 | 0.013 | 0.980 | −0.105 | −0.010 |
| | **Farm Price in US$ per cwt** | 0.112 | 0.018 | 0.261 | 6.365 | 0.000 | 0.075 | 0.148 | 0.914 | 0.805 | 0.125 |

[a]Dependent Variable: Loan Rate US$ per cwt
*...t values are shown here as a standard output of Correlation Analysis tool and are not relevant since base data is in the nature of yearly aggregates and completely enumerated population.

## 6. Conclusion

*The above two point put the model finally considered into perspective of correlations and significance of the same.*

*The switching to Loan Rate as dependent variable still retained the significance as well as correlation coefficient of 0.914 in terms of its dependence on Farm Prices on the same set of population data. This is a pointer for Policy Administrator showing Total Use/Disposition stock being the factor considered most by Policy Makers on the Loan Rate in US$ per cwt (0.986) than the market factors affecting the Total Use/Disposition stocks affecting actual farm prices (0.853).*

This puts in perspective the Marketing Assistance Loan (MAL) program is a price-protection program for targeted field and row crops that helps farmers avoid having to sell when prices are at relative market lows. Products eligible for MAL are called loan commodities. The program ensures a floor price and interim pricing for crops.

Farmers can take out a loan from MAL using their crops as collateral. If market prices increase above the loan rate, the farmer may reclaim the crop, and repay the loan. If crop prices fall, the farmer may forfeit the crop or take a loan deficiency payment, a marketing loan gain, or commodity certificates (paper certificates that have a dollar value pegged to commodity prices) to repay the loan. All these methods result in the farmer receiving a financial gain from the difference between the initial loan and the lower repayment rate.

The outcome of the analysis indicates that while crops (Disposition stocks) serve as a means to obtain the Loan but *it is the strong correlation and interdependence between Loan Rate in US$ per cwt and Farm Price in US$ per cwt that decides how much farmer wants to declare the Disposition Stock to the Bank for purpose of availing Loan against crops. On the other hand, Loan Rate in US$ per cwt at the time of trade is seen/ expected to decide the Supply Total to market (with production & imports variables in action) having a bearing on the point of farmer–market supply price and quantity at transaction levels.*

## 7. Future Scope

This research can be extended to Rotational Crops grown on same the farms as these rice farms to better understand the policy imperatives, desired versus actual policy directions & outcomes and the key & significant relationships between the policy, market, and operational variables.

## References

[1,2,3] Deepak Kumar* and Prasanta Kalita. Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries.

[4] Kannan, E., Kumar, P., Vishnu, K., & Abraham, H (2013). Assessment of pre and post-harvest losses of rice and red gram in Karnataka. Agricultural Development and Rural Transformation Centre, Institute for Social and Economic Change: Bangalore, India.

[5]
(i) Sarkar, D., Datta, V., & Chattopadhyay, K. S (2013). Assessment of pre and post-harvest losses in rice and wheat in West Bengal. Agro-Economic Research Centre, Visva-Bharati, Santiniketan; Santiniketan, India.(ii) Calverley, D (1996). A study of loss assessment in eleven projects in Asia concerned with rice. FAO; Rome, Italy.(iii) Bala, B. K., Haque, M. A., Hossain, M. A., & Majumdar, S (2010). Post harvest loss and technical efficiency of rice, wheat and maize production system: Assessment and measures for strengthening food security. Bangladesh Agricultural University; Mymensingh, Bangladesh.(iv) Majumder, S., Bala, B., Arshad, F. M., Haque, M., & Hossain, M (2016). Food security through increasing technical efficiency and reducing postharvest losses of rice production systems in Bangladesh. *Food Security,* 8, 361–374.doi:10.1007/s12571-016-0558-xiv) Costa, S. J (2014). Reducing food losses in Sub-Saharan Africa (improving post-harvest management and storage technologies of smallholder farmers). UN World Food Programme; Kampala, Uganda.
(v) Abedin, M., Rahman, M., Mia, M., & Rahman, K (2012). In-store losses of rice and ways of reducing such losses at farmers' level: An assessment in selected regions of Bangladesh. *Journal of the Bangladesh Agricultural University,* 10, 133–144.doi:10.3329/jbau.v10i1.12105.(vi) Basavaraja, H., Mahajanashetti, S., & Udagatti, N. C. Economic analysis of post-harvest losses in food grains in India: A case study of Karnataka. *Agricultural Economics Research Review,* 20, 117–126[6] Food and Agricultural Organization of the United Nations (website) https://www.fao.org.
[7] Food and Agriculture Organization of the United Nations (FAO Representation in India) "India at a Glance".
[8] **ID**: NY.GDP.PCAP.CD (Source: World Bank national accounts data, and OECD National Accounts data Files The World Bank. "GDP Per Capita (Current US$)".
[9] Food and Agriculture Organization of the United Nations (FAOSTAT Help desk at faostat@fao.org or call +39 06 5705 5303). "Countries by Commodity" Items > "Sugar Refined," and "Rice, milled."
[10] WTO Secretariat, World Trade Organization. "World Trade Statistical Review 2020" Page 92
ISBN 978-92-870-5023-6 (Print) / 978-92-870-5024-3[11] Asit Ranjan Mishra, Mint. "India Breaks Into the Top 10 List of Agri Produce Exporters".
[12] Laura Driscoll, https://straydoginstitute.org/agricultural-subsidies/#_edn1.
[13] USDA, https://naldc.nal.usda.gov/download/CAT87210025/PDF.
[14] USDA, https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2019/arc-plc_overview_fact_sheet-aug_2019.pdf.
**[15]** Elaine Shannon, Editor-in-Chief and Publisher https://farm.ewg.org/subsidyprimer.php.
[16] USDA, ***18 crops*** https://www.fsa.usda.gov/Internet/FSA_File/dcp03.pdf.
[17] USDA, Countercyclical Payments:https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2019/arc-plc_overview_fact_sheet-aug_2019.pdf.
[18] Elaine Shannon, Editor-in-Chief and Publisher, Subsidy Primer - 2008 farm bill.
[19] USDA, Agriculture Risk Coverage program 2014.
[20] Elaine Shannon, Editor-in-Chief and Publisher, Who Benefits Most From Farm Subsidies?[21] Elaine Shannon, Editor-in-Chief and Publisher, The wealthiest 1 percent of farm operations (2019).[22] Chris Edwards, https://www.downsizinggovernment.org/agriculture/subsidies.
[23] Deepak Kumar* and Prasanta Kalita, Reducing Postharvest Losses during Storage of Grain Crops to
Strengthen Food Security in Developing Countries [24] USDA Farm Support Agency, Marketing Assistance Loan (MAL).