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IMPROVING LIVES OF INDEBTED FARMERS USING DEEP LEARNING

[1] A NAGARAJU, [2]P. VIJAY

[1](Assistant Professor), MCA, **DANTULURI NARAYANA RAJU COLLEGE(A) PG COURSES, BHIMAVARAM ANDHRA PRADESH**

[2]MCA, scholar, **DANTULURI NARAYANA RAJU COLLEGE(A) PG COURSES, BHIMAVARAM ANDHRA PRADESH**

ABSTRACT

Farmer suicides have become an urgent social problem which governments around the world are trying hard to solve. Most farmers are driven to suicide due to an inability to sell their produce at desired profit levels, which is caused by the widespread uncertainty/fluctuation in produce prices resulting from varying market conditions. To prevent farmer suicides, this paper takes the first step towards resolving the issue of produce price uncertainty by presenting PECAD, a deep learning algorithm for accurate prediction of future produce prices based on past pricing and volume patterns. While previous work presents machine learning algorithms for prediction of produce prices, they suffer from two limitations: (i) they do not explicitly consider the spatio-temporal dependence of future prices on past data; and as a result, (ii) they rely on classical ML prediction models which often perform poorly when applied to spatio-temporal datasets. PECAD addresses these limitations via three major contributions: (i) we gather real-world daily price and (produced) volume data of different crops over a period of 11 years from an official Indian government administered website; (ii) we pre-process this raw dataset via state-of-the-art imputation techniques to account for missing data entries; and (iii) PECAD proposes a novel wide and deep neural network architecture which consists of two separate convolutional neural network models (trained for pricing and volume data respectively). Our simulation results show that PECAD outperforms existing state of-the-art baseline methods by achieving

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significantly lesser root mean squared error (RMSE) - PECAD achieves ∼25% lesser coefficient of variance than state-of-the-art baselines. Our work is done in collaboration with a non-profit agency that works on preventing farmer suicides in the Indian state of Jharkhand, and PECAD is curre.

1.INTRODUCTION

In the last two decades, the issue of agrarian distress (and other related socio-economic problems such as indebted-ness, loss of agricultural income, etc.) have led to a signif-icant increase in suicide rates among small-scale farmers, especially in developing countries such as India, Pakistan,etc.Around300,000Indianfarmersha vecommittedsuicide since 1995. As of 2014, 60,000 farmers committed suicidein the Indian state of Maharashtra alone, with an average of10suicideseveryday(NCRB2019).

There area myriad off actors that lead to farmer suicides, e.g., crop failures, low farm productivity, an inability to achieve profits, inefficient cold chain management resultingin wastage of agricultural produce, lack of irrigation facili-ties,andinsurmountabledebt.However,oneke yfactorthatcontributes to farmer suicides is the uncertainty associated with agricultural prices and markets, i.e., variations in global market condition scanlead to abrupt fluctuations in prices of agricultural produce at alocalleve l(Barik2018).Due to this uncertainty over prices, indebted small-scale farmers who often lack advanced technological resources and knowledge about global market conditions are unable to make accurate decisions about when (and where) to sell their produce. Asa result, they are unable to earn desired profits on their pro-duce and repay their agricultural loans (see Figures 1a and1b), which causes many of these farmers to commit suicide(Panagariya2008).

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(a)Farmers Protesting by

b) Huge Demand for Loan

Throwing their Rally Figure 1: Agrarian Distress in India

Thus, immediate steps need to be taken to alleviate is-suesofthesefarmers.RecentadvancesinMachineLearning(ML)techniqueshavemadeitpossibletoapplylearningalgorithms successfully to different social problems (TambeandRice2018).Asafirst step in solving problems off armers outlined above, this paper proposes an AI/ML approach to answer the following question: *Can* data-driven approaches use historical pricing and volume patterns atdifferentmarketstopredictfuturepricesofagriculturalpro-duceatthesemarkets?TheseAI/MLapproachescanthen be used by farmers to select intelligent strategies for sellingtheir produce, e.g., via future price predictions, farmers candecidewhen(inthefuture)theyshouldselltheirproduceinordertomaximizetheirprofit.

There are several challenges that need to be solved to answer this question. First, existing datasets on pricing pat-terns[1]areverysparse(i.e., they have lots of missing entries),which hinders the training process. Second, future produce prices have along-term temporal dependence on pastprices(e.g., the price of tomatoes in August 2019 may depend on their price in August 2018) and a spatial dependence on the pricesat nearby markets(e.g.,prices at near by markets may be similar, as opposed to geographically distant markets),andthus,itisimportanttodeveloppredictionmodelswhichcanexplicitlycapturethisspatio-temporaldependence.

Whilepreviousworkpresentsalgorithmstopredictfutureproduceprices,they(i)donotexplicitlyconsiderthespatio-temporal dependence of future prices on past data; and as aresult,(ii)theyrelyonclassicalMLprediction models(e.g.,decisiontrees)whichoftenperformpoorlywhenappliedto spatio-temporal datasets (we validate this in our experiments). These shortcomings limit the accuracy (and hence, usability) of these methods in the real-world

In this paper, we address these shortcomings by proposing PECAD (**P**rice **E**stimation for **C**rops using the **A**pplication of **D**eep Learning), a novel neural network architecture topredict future prices of agricultural produce. In order to ad-dress

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thes hort comings in previous work, PECAD makes the following novel contributions. First, it collects real-world prices and (produced) volume of different crops at1,350agricultural markets in India over a period of 11 years (i.e.,2008 to 2018) from Agmarknet.gov.in[1] (an official Indian government administered website). Second, PECAD pre-processes this raw dataset via state-of-the-art imputation(and other) techniques to account for missing data entries. Third, using this data as input, PECAD proposes a novel neural network architecture inspired by the wide and deep learning paradigm (Cheng et al. 2016), which jointly trainswidelinearmodelsanddeepneuralnetworks.However,in-steadofusingcross-product feature transformations as input to the wide line armodels, PECAD uses an ovel combination of two separate convolutional neural network (CNN) models for pricing and volume data respectively (for the crop under consideration),andusestheseCNNmodelsasin-put to the wide linear model. Our simulation results show out perform sexisting state-of-the-art baseline methods – it achieves 25% lesser coefficient , which emphasizestheimportanceofexplicitlymodelingthespatio-temporaldependenceoffuturepricesonpastdatainsideourMLalgorithm Our work - profitagency that works on preventing theIndianstateofJharkhand(namewithheldforanonymity),andPECADiscurrentlybeingreviewedbythemforpotentialdeployment.

Related Work: We discus sprior AI/MLresearchthatassistsinalleviatingagrariandistress.(Youetal.2017)proposed deep Gaussian processes to predict crop yields using remote sensing data. However, their approach relies on gathering satellite images of fields, which can be expensive to obtain in low-resource environments in developing countries. In our work, we rely on easily available pricing .Next,(Chen,Nowocin,and Marathe 2017) proposed a hardware and software solution to reduce spoilage of agricultural crops. (Ma et al.2019) is most closely related to our research, as they also build acropprice prediction model using data from the same source[1]. Unfortunately, they fail to exploit spatio-temporal properties of pricing and produced)volumedatafordifferentcrops,whichleadstopoorperformanceaccuracy(aswesho w in our experiments). In our work, we use specific formsofconvolutionalneuralnetworkstounco

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verspatio-temporaldependenciesinpricingandvolumedata

2. EXISTING SYSTEM

In the existing system Farmers, as well as agriculture, are the foundation of life. Numerous works has been done towards the enhancement of agriculture by developing technologies that support directly and indirectly to agriculture. A range of research shows that with the various enhancements in the field of ICT (Information and Communication Technologies), the farmers are unable to take its advantage and fail to get the proper sale value for their crops. An interface that benefited the farmers by providing the information related to the advancement of agriculture techniques. Various technical approaches made in agriculture, mostly in the field of food and supply chain management. The incorporation of blockchain technology in agriculture has improved the efficiency of the agriculture supply chain by reducing the need for verification of data. However, the technology proposed benefited only the producers in terms of maintaining the accuracy of data for supply.

Disadvantages:

- Transaction depends on third party.
- Data stored in local servers it means data may be not secure.

3. PROPOSED SYSTEM

The Proposed Farmer's portal is a single gateway through which the e-commerce activity of crops can be performed. The users' experience of the portal can be tailored according to the individual need. It is a single access point i.e., everything is in a single place, the only thing needed is single login to approved users.

User: A user can be a buyer or a seller. The seller may be a farmer or a representative of him. Device: The user can interact through the portal using a computer or a laptop. Interface: To access the portal, the user needs to register using a sign-up. The registered user logins using the correct credentials. Once the user signs in successfully. The user will have access to the portal/ interface. A user can view available items that are crops and seeds with their price.

Advantages:

- Accurate Price Predictions
- Market Strategy Optimization

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- Data-Driven Insights
- Profit Maximization.

4. OUTPUT SCREENS

Admin login:

Farmerregister:

farmer login:

KNN:

farmer details:

5. CONCLUSION

hardware (to train and run PECAD). Thus, we propose deploying PECAD as a stand-alone web service that the agencies could use without our intervention. Finally, PECAD represents a single piece of the puzzle that needs to be solved for preventing farmer suicides, there are many other pieces. For example, PECAD's successful

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deployment A few implementation challenges need to be solved when PECAD gets deployed by non-profit agencies working with indebted farmers. First, PECAD's predictive performance can potentially be improved by incorporating historical weather patterns, which can play a role in determining future crop supply (and hence, the future crop price). However, deep learning methods are rarely used to model weather in the real-world, as physical models are far more accurate at predicting future weather. Thus, PECAD needs to be integrated with physical weather prediction models (as part of future work). Further, sophisticated deep learning approaches to predicting future produce prices (such as PECAD) may raise suspicions among low-literate farmers. Public awareness campaigns in the agencies working with this program would help overcome such fears and to encourage participation. Also, non-profit agencies often do not prioritize spending their limited resources to buy sophisticated computer depends crucially on availability of long-term crop pricing and volume patterns. While Agmarknet.gov.in makes this information available for Indian markets, there are no analogous data repositories for other developing countries.

This paper presents PECAD, a deep learning algorithm for accurate prediction of future produce prices based on past pricing and volume patterns. Previous ML algorithms for predicting produce prices do not explicitly consider the spatio-temporal dependence of future prices on past data, which leads to significant shortcomings. PECAD handles these issues by proposing a novel wide and deep learning architecture in which two separate convolutional neural network models are trained for pricing and volume data respectively (for the crop under consideration). Our simulation results show that PECAD outperforms existing state-of-the art baseline methods by achieving 25% lesser coefficient of variation. Our work is done in collaboration with an Indian

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