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Approach of Business Analytics in Agriculture

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This article summarises the advantages of analytics for different stakeholders (such as farmers and processors) along the full agricultural supply chain and provide examples of successful business practises; propose fruitful directions for analytics to help the agriculture industry. Compile data and their sources on a digital platform we built for successful use of analytics in agriculture. We first create a typology of agricultural activities and emergent analytics challenges to organise these directions. Physical Supply Chain, Markets, Environment and Sustainability, Physical Supply Chain and Policy and Regulations.

Agribusiness Analytics: Opportunities and Challenges

Agriculture, which is the organised production of commodities derived from plants and animals for direct or indirect human consumption, is essential to human existence. Today's population growth, the underprivileged socioeconomic conditions of many farmers around the world, and expanding environmental and sustainability concerns all provide significant hurdles for this industry. Analytics provides a practical means of comprehending and resolving these issues. Our report suggests new methods for using analytics in agriculture and offers areas for future study.

By 2050, 2 billion more people are expected to live on the planet. It is essential for agriculture to become more efficient and raise its output per unit of inputs such as land and water since the growing population is encroaching on agricultural land. This task faces numerous important restrictions.

The agricultural sector is proactively taking action to address these issues. The sector has heavily invested in research and development to create crop types that yield more while using less water and nutrients, as well as to create more effective water irrigation techniques. A significant amount of work has also been put into developing digital platforms that increase market efficiency, including e-Choupal Chen and Tang (2015). Governmental economic and regulatory support is necessary for many of these initiatives. To improve the financial and environmental sustainability of various agents in agriculture operations and supply chains, policymakers therefore work to establish and execute policies. These policies range from offering targeted assistance or subsidies to establishing new markets (such as grower assistance programmes to advance biofuel supply chains) or reorganising already-existing ones (e.g., market integration in Europe and India). In order to identify policies that will be effective, it is crucial to have an understanding of the context of agriculture.

Physical Supply Chain

The quality of inputs has a direct impact on how productive agricultural activities are. To this purpose, research is needed to increase the quality of seeds, agricultural development aids like water, and crop protection goods like herbicides and pesticides. Since seeds capture some

essential contextual information for agriculture, we will discuss them in the most detail in the sections that follow.

Market-leading commercial seed companies like Syngenta and Corteva provide a wide variety of seeds (e.g. Corteva offers more than two hundred seeds each year in the U.S). This broad selection of seeds is intended to provide varieties that are adapted to particular geographic and climatic regions. For instance, Minnesota has a brief spring season with enough irrigation capacity, whereas Texas normally has a lengthy and dry spring and summer. The two places need different seeds as a result of these variations. Separate analytical concerns pertaining to seed development and sales companies and farmers purchasing these seeds are covered. Since they are produced internally by business organisations, the seed data are often confidential.

However, crowdsourcing competitions (like those organised by Syngenta) offer a chance to create and test fresh predictive algorithms that are tailored to the agribusiness industry. The interpretability of the present prediction models is an understudied topic from a methodological standpoint. Many times, businesses have scientists and researchers on staff that have had years of expertise and may contribute to this process. There aren't many approaches for fusing formal prediction methods with expert assessments, with a few exceptions being Bansal *et al.* (2017) and Bansal and Gutierrez (2020).

Agriculture depends heavily on water, which is increasingly dwindling in supply. The main cause of this scarcity in wealthy countries with slow population development is altered weather patterns. For instance, California went through droughts in 2013 and from 2016 through 2020, but in 2015 and 2021, the state received more rain in a month than it typically gets in a year. Water is becoming increasingly limited in developing countries as a result of rising temperatures and quickly expanding populations that are eroding ground water reserves faster than they are being replenished naturally. The difficulties caused by a lack of water have begun to be addressed by recent analytics research. The systematic disparities in irrigation water availability for fields that are close to water streams have been studied in field journals (Yapa *et al.* 2020).

Unlike required inputs (seeds and water), crop protection chemicals like fertilisers, insecticides, and herbicides are optional; in most circumstances, not applying them may lower (but not entirely eliminate) the yield in a field. Crop selection, the application of fertilisers and raw materials, and harvesting all take place during the production process in agriculture. It is helpful to consider each factor separately when choosing a crop, such as whether the food is owned by a vertically integrated business like Heinz or a single farmer. Vertically integrated businesses strive to manufacture high-quality goods in sufficient quantities, but obstacles such as the environment and conflicting incentives may get in the way. Open fields' agricultural productivity is susceptible to erratic yields and specific weather conditions.

Providing Market Intelligence

Information is important in agriculture. Farmers must gather information or draw on prior knowledge to forecast yields and prices. Aside from quality, intermediaries also need to be aware of purchasing and sales pricing. Last but not least, customers are want greater information on the origins of their food. This section outlines what is known about each of these contexts, suggests research goals, and identifies some new business models that aim to eliminate middlemen from agricultural supply chains.

Farmers must choose which crops to plant, how to care for those crops, when and where to sell their produce, and when and where to sow them. These three phases of crop production each call for a significant quantity of knowledge.

This is a remarkably difficult choice that necessitates knowledge of the soil characteristics in their plot and how these affect distributions of yield and quality, as well as some understanding of the future price distribution for various sales channels at the time of harvest, which will be months from now (Zhang and Swaminathan 2020).

Farmers, especially smallholder farmers, experience severe cash limitations during the sowing period. Farmers are forced to accept poorer yields and lower earnings even if they may be aware that better seeds will generate a larger profit during the selling season.

Conclusion

For the world population's nutrition and health, agriculture is a crucial industry. Business analytics in agriculture may considerably boost this industry's efficiency and help agriculture supply chain partners survive and thrive. Finally, it's critical to understand that agriculture is a human-centric sector, both in terms of the people who work in it (such as farmers and processors) and who profit from it (end-consumers). This human component is crucial for guiding farm analytics. For instance, it's important to comprehend how different stakeholders in agriculture make decisions, their biases, and the preferences and objectives they factor into those decisions.

This information can then be utilised to create contracts that encourage desired behaviours, decision support tools to aid in decision-making, and the necessary governmental and structural backing.

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