

# Contribution of Artificial Intelligence in Market Gardening: Case of Burkina Faso

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## Abstract

This research focuses on the contribution of Artificial Intelligence to market gardening in Burkina Faso using drones for crop monitoring, disease detection, and targeted spraying, as well as forecasting systems for optimizing irrigation and planting schedules. Artificial Intelligence is applied in several areas of life and market gardening is no exception. The objective of this study is to show that AI could have a positive impact on the production of market gardening in Burkina Faso. This study is important and new because AI is little known by many market gardening professionals. In this study, we collect primary data through market gardening professionals. We analyze and compare those who use AI and those who do not use it in the context of their work and we identify the impact of new technologies such as AI in market gardening. The comparative result shows an increase of production for those who use such technology under the same condition of production. The expected result is to demonstrate the impacts in terms of profitability in the use of AI and to encourage professionals in the field to become active in its use.

## Keywords

Artificial Intelligence, Market Gardening, Harvest Robotization, Weeding Control System, Task Automation

## 1. Introduction

Artificial intelligence (AI) can be understood as a process of imitating human intelligence that is based on the development and application of algorithms executed in a dynamic computing environment. Artificial intelligence is nowadays taking more and more part in our lives [1]. AI in market gardening is becoming more

and more important for market gardening professionals and for consumers. Indeed, intelligent market gardening offers better yields, increased efficiency and lower operating costs. Based on machine learning and deep learning, labor works such as weeding, spraying and harvesting are managed by AI-driven systems. Deep learning has provided natural ways for humans to communicate with digital devices [2]. AI could reduce labor in market gardening and would generate spectacular returns.

## 2. Methodology Used

All scientific work must respect scientific procedures. In this research, we use the mixed method which is a scientific method that is both quantitative and qualitative. Data collection is done through primary data which is done by a questionnaire and interviews with market gardening professionals and by the use of our own AI equipment for the collection of data on their activities. Our secondary data is obtained through documentation.

### Determination of the Study Sample

Sampling is the operation that consists of taking a certain number of elements to process or observe, that is to say, that the sample is a subset of the population. For our case, we use the formula which allows us to determine the sample size using a 10% margin of error. We then apply:

$$N = Z^2 \frac{P \times Q}{E^2}$$

$\alpha = 0.5$  implies that  $Z = 1.96$ .

$P = 0.5$ .

$Q = 1 - p = 0.5$ .

$E =$  between 1% and 10%.

$N$ : represents the sample size.

$Z^2 =$  reduced center normal law.

$\alpha =$  represents the degree of confidence.

$E^2 =$  represents the maximum or systematic error.

We will therefore have

$$N = 1.96^2 \times 0.5 \times 0.5 / 0.1^2 = 0.9604 / 0.01 = 97.$$

That is to say 97 market gardening professionals.

## 3. The Fields of Action of AI in Market Gardening and Cultivation

The different fields of action in market gardening are as follows.

### 3.1. Control and Management of Information

In market gardening activities, controlling the temperature, climatic conditions, soil quality and even water potential are important for those in the field. Understanding climatic phenomena and soil quality allows you to anticipate decisions and have insight into how to carry out this work. Artificial intelligence in market gardening

culture helps for irrigation, weeding, spraying with the help of sensors and other means embedded in robots and drones. These technologies save the excessive use of water, pesticides, and herbicides, and maintain the fertility of the soil [3].

### 3.2. Manage Seasonal Forecast Systems

By collecting data over a large period of time, AI can generate seasonal forecasting systems. Market gardening professionals can take into account the probability of certain recurring events in their forecast. It is evident that AI technology has a key role to play in the future market gardening culture sector [4].

### 3.3. Use of Drones and Video Surveillance

Drones which are controlled by artificial intelligence make it possible to monitor operations. These drones collect data which can then be analyzed and used. This data can then identify the various problems on the site and proposed solutions can be identified.

A monitoring system can be deployed to regularly check the status of the crops such that in case of pest attacks or when the crop health looks degraded it can be efficiently noted and necessary steps can be taken [5].

## 4. Results

The results that we present show on the one hand the rate of use of AI in market gardening in Burkina Faso and on the other hand, we show the impact of the use of AI in market gardening production culture by comparing the production over a year of production of a professional market gardener who does not use AI and another that we have integrated our AI equipment for testing. The AI used relates to the management of seasonal forecasts and the use of drones that we had deployed on the sites concerned.

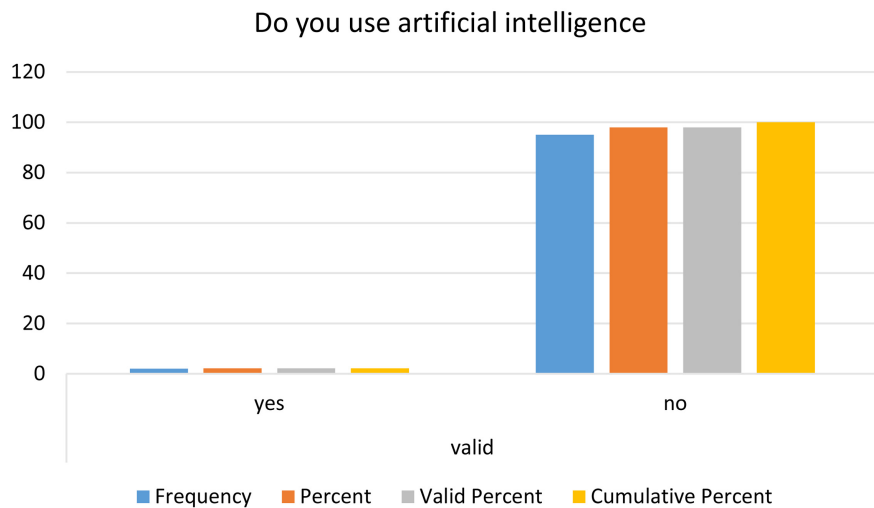
### 4.1. Rate of Use of AI in Burkina Faso in Market Gardening

We ask the question to 97 market gardening professionals about their use of AI. The result is as follows.

**Table 1.** AI usage rate at BF.

Do you use artificial intelligence				
	N		Valid	97
			Missing	0
Do you use artificial intelligence in market gardening				
		Frequency	Percent	Valid Percent
	yes	2	2.1	2.1
valid	no	95	97.9	97.9
	total	97	100.0	100.0
				Cumulative Percent
	yes			2.1
	no			100.0

**Table 1** shows us the frequency, the percent, the valid percent, and the cumulative percent of the use of AI. We clearly see a low use of AI in the field despite these benefits. Indeed, There has been a significant development in digital agriculture management applications, which has impacted information and communication technology (ICT) to deliver benefits for both farmers and consumers [6].



**Figure 1.** AI usage statistics.

**Figure 1** shows a low rate of use of AI in the field of market gardening and cultivation.

#### 4.2. Performance Statistics of a Market Gardening Professional Not Using AI

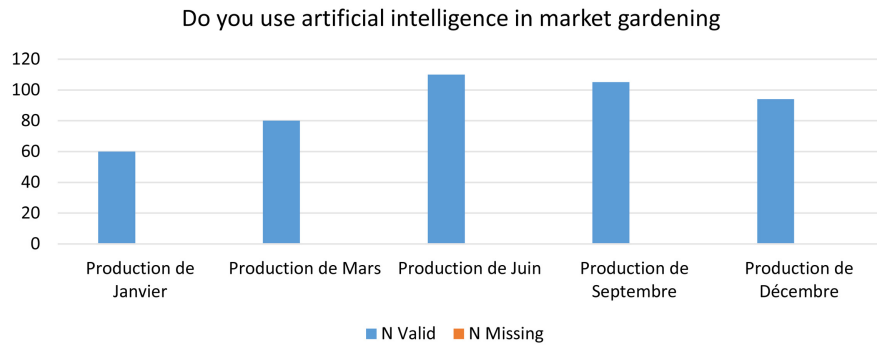
We analyze the performance over a period of one year of production of a market gardening professional not using AI.

**Table 2** shows the rate of yield in kilograms over a period of one year which shows that production is not continuous. We see an increase and a reduction on both sides of production due to uncontrolled factors that could have been resolved with the use of AI.

**Table 2.** Production rate over one year.

		Production of January	Production of March	Production of June	Production of September	Production of December
N	Valid	60	80	110	105	94
	Missing	0	0	0	0	0

**Figure 2** shows us a variance in quarterly production, which of course is not constant and does not respond to any logic.



**Figure 2.** Statistics on production without use of AI.

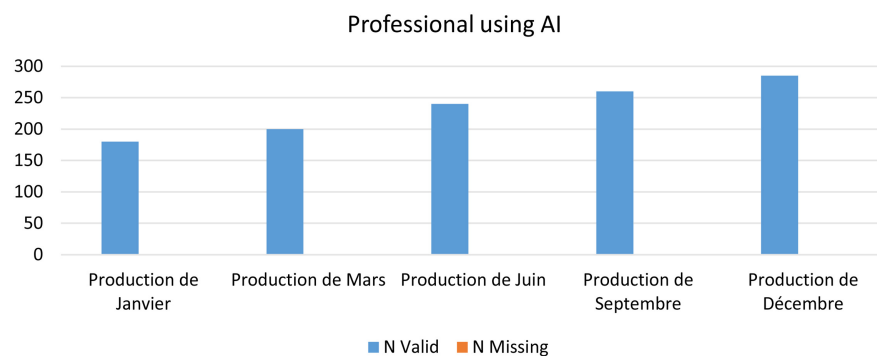
### 4.3. Statistics on a Market Gardening Professional Using AI

For another producer who has decided to launch into AI, for which we have deployed the infrastructure and collected the data, we show the results in terms of yield.

**Table 3.** Production rate over one year.

		Production of January	Production of March	Production of June	Production of September	Production of December
N	Valid	180	200	240	260	285
	Missing	0	0	0	0	0

**Table 3** clearly shows us a consistency and an increase in production due to the use of drones and seasonal forecasting techniques. Factors that would have led to a reduction in production were ruled out thanks to AI techniques used to eliminate risk factors. AI-based technologies increasingly substitute and complement humans in managerial tasks such as decision making [7].



**Figure 3.** Production statistics with the use of AI.

**Figure 3** shows us exactly how AI is beneficial through rational and constant production, allowing professionals in the field to be more confident and reassured about the consistency of their production.

Drone is used bi-weekly for disease detection and targeted pesticide spraying,

reducing chemical use.

Forecasting Systems: Used daily to optimize irrigation schedules, minimizing water wastage and preventing drought stress.

Production Increase: The combination of drones and forecasting systems resulted of increase due to better crop management and reduced losses.

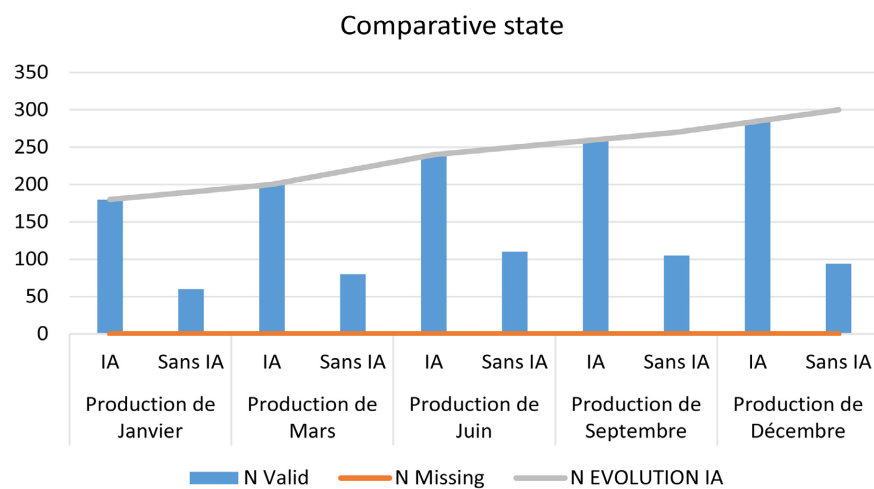
#### 4.4. Comparison and Deduction on the Contribution of AI in Market Gardening

We analyze by comparing the 2 previous situations and we note the effectiveness of the contribution of AI in market gardening. It is important to clarify that they produce the same crops under similar conditions. Galmi onion is the crops which scientific name is *Allium Cepa*. Their farmer size is the same.

**Table 4.** Comparison of yields.

		Production of January		Production of March		Production of June		Production of September		Production of December	
		IA	Sans IA	IA	Sans IA	IA	Sans IA	IA	Sans IA	IA	Sans IA
N	Valid	180	60	200	80	240	110	260	105	285	94
	Missing	0	0	0	0	0	0	0	0	0	0

**Table 4** compares productions and shows us the yield gaps that may exist between the use of AI and the lack of use of AI.



**Figure 4.** Comparative state.

**Figure 4** shows us a rising curve on the one for which we used AI, indicating a clear and precise confirmation of the added value of AI on market gardening.

## 5. Conclusion

In this research, we have shown through a scientific and rational approach the

benefits of Artificial Intelligence in market gardening. Through the AI tools that we used on a market gardening professional, we demonstrated the relevance in terms of yield, compared to those who do not use them. We also concluded through our research that there was little use of AI in Burkina Faso in the field of market gardening. One of the important application areas of AI is agriculture. On a global scale, this field is faced with numerous challenges that can have significant effects on harvests and cause serious environmental damage [8]. It is important to clarify that barriers to AI Adoption in Burkina Faso include the acquisition and maintenance of drones and AI software are expensive. Limited knowledge and skills prevent adoption. Limited internet connectivity in rural areas. To increase AI adoption, the government can organize permanent special training and also reduce the cost of the equipment.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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