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Harpreet Singh
Assistant Professor,
Department of Economics,
Panjab University,
Chandigarh, Punjab, India

Correspondence
Harpreet Singh
Assistant Professor,
Department of Economics,
Panjab University,
Chandigarh, Punjab, India

An overview of farm size and productivity in Indian agriculture

Harpreet Singh

Abstract
The debate on farm size productivity revolves around the relationship between the size of a farm and its productivity levels. Many scholars have reported conflicts and debates surrounding the relationship between farm size and productivity. The present study attempts to analyse literature and draw conclusion on the farm size productivity debate in context of Indian agriculture. Early studies on Indian agriculture suggested an inverse relationship between farm size and productivity, indicating that smaller farms tend to be more productive. However, over time literature emerged suggesting weakening of the inverse relationship.

Keywords: Farm size and productivity, Indian agriculture

Introduction
Farm size productivity is a complex and multifaceted concept that has been the subject of much scholarly debate. Researchers and policymakers have identified various factors that influence farm size productivity, including the internal characteristics of farms themselves and external factors such as technology adoption and market structures. These factors interact with each other in intricate ways, making it challenging to determine the exact relationship between farm size and productivity. The debate on farm size productivity revolves around the relationship between the size of a farm and its productivity levels. Many scholars have reported conflicts and debates surrounding the relationship between farm size and productivity. On one hand, there are arguments that suggest larger farms are more productive due to economies of scale, while on the other hand, there are arguments that support the idea that smaller farms can be more efficient and productive through various factors such as market participation, technological progress, and allocation efficiency. One of the prominent findings in the literature is the inverse relationship between farm size and income. This inverse relationship gained ground with the work of Sen (1962, 1964) [28-29] and has been supported by numerous studies in developing countries.
India is renowned for its agricultural sector, which plays a vital role in the country's economy and provides livelihoods for a significant portion of its population. The agricultural sector in India contributes to the national GDP and employs a large percentage of the population, particularly in rural areas. However, despite its importance, Indian agriculture faces numerous challenges that affect farm productivity. One significant factor that affects farm productivity in India is the size of the farms themselves. The relationship between farm size and productivity in Indian agriculture has been a subject of extensive research and debates. The inverse relationship between farm size and productivity in Indian agriculture has been a topic of frequent debate. Several studies have presented evidence supporting the existence of an inverse relationship between farm size and productivity in India.

Theoretical Perspectives on Farm Size Productivity
Several theoretical perspectives have been put forth to explain the relationship between farm size and productivity. Economies of scale theory suggest that larger farms can take advantage of economies of scale, leading to higher productivity levels. The economies of scale, allowing larger farms to achieve higher levels of productivity due to their ability to invest in more advanced technology, machinery, and specialized labor.

Additionally, the resource endowment theory argues that smaller farms may be able to optimize their limited resources, such as land, labor, and inputs, more efficiently, leading to higher productivity levels. Contrary to the economies of scale theory, the allocative efficiency theory suggests that smaller farms may have a better ability to allocate resources effectively, leading to higher productivity levels. On the other hand, the market participation theory suggests that smaller farms may have better access to local markets and niche markets, allowing them to command higher prices for their products and ultimately achieve higher productivity levels. Furthermore, the socio-economic traits of farmers play a crucial role in determining farm size productivity. Farmers with larger land holdings may have access to more resources, such as credit and training, which can enhance their decision-making ability and production practices. Additionally, factors such as age, education level, occupation, cultivation experience, and access to credit and training also influence the productivity of farm size. Overall, the relationship between farm size and productivity is complex and nuanced, with various theories and perspectives proposing different explanations.

Researchers have taken different approaches to investigate the relationship between farm size and productivity. Some studies have analyzed cross-sectional data, comparing the productivity of farms of different sizes at a specific point in time. These studies have found mixed results, with some suggesting an inverse relationship between farm size and productivity, while others finding a positive or non-monotonic relationship instead. Other studies have used longitudinal data, examining changes in the productivity of individual farms over time. These longitudinal studies have also yielded mixed findings, with some indicating a positive relationship between farm size and productivity as farms expand over time, while others showing that farm size and productivity are not necessarily correlated. Furthermore, there is a growing body of research that takes into account factors such as farm management practices, technology adoption, and access to resources. By considering these additional factors, researchers aim to provide a more comprehensive understanding of the complex relationship between farm size and productivity. Overall, the theoretical perspectives on the relationship between farm size and productivity are diverse and varied. They emphasize the importance of considering various contextual factors and socio-economic traits of farmers, as well as the need for more comprehensive and nuanced research methodologies.

Empirical Studies on Farm Size and Productivity

Numerous empirical studies have been conducted to examine the relationship between farm size and productivity (Barrett, 1996) [34]. These studies have yielded mixed results, with some supporting the inverse relationship and others finding no significant relationship or even a positive relationship. In recent years, there has been growing recognition of the need to consider various factors and contexts when examining the farm size-productivity relationship (Barrett, 1996) [34].

Farm size has been extensively studied in relation to productivity in Indian agriculture. The inverse relationship between farm size and output per acre is a well-known phenomenon. This relationship exists independently of production relations and reflects a static superiority of small-scale over large-scale production, particularly in areas with backward technology. However, it is important to note that the observed negative relation between output per acre and farm size is likely due to an inverse relation between size and other inputs rather than scale diseconomies. Technological progress, such as the introduction of chemical fertilizers, labor-saving machinery, and modern irrigation equipment, is likely to diminish the inverse relationship between farm size and productivity. Additionally, empirical evidence confirms a strong correlation between farm mechanization and agricultural productivity, with states having greater availability of farm power showing higher productivity.

There is strong evidence from numerous studies conducted in the 1960s and 1970s showing crop productivity per unit of land decreased as farm size increased (Sen 1962, 1964; Mazumdar 1965; Khusro 1968; Hanumantha Rao 1966; Saini 1971; Bardhan 1973; Berry 1972) [28-29, 21, 20, 16, 26, 1, 3]. Bardhan (1973) [2] found constant returns to scale in predominantly wheat areas and diminishing returns in predominantly paddy areas. Ghose (1979) [14] discusses the inverse relationship between farm size and land productivity in Indian agriculture, which is influenced by technology and not production relations. Smaller farms have higher output per acre and the inverse relationship between farm size and land productivity. Also, the labour use per unit of land varies inversely with farm size. He concluded that technological progress may erode the superiority of small-scale production. Srivastava, Nagadevara, and Heady (1973) [32] found evidence of constant returns to scale relative to farm size in Indian agriculture. They also argued that changes in output per hectare are explained by changes in inputs thus generalizations about returns to scale in Indian agriculture are not possible.

Some analysts have questioned the idea that productivity and farm size are inversely correlated. A number of analysts investigated the causes or contributing variables to smallholders' superior production (Berry and Cline 1979; Bhalla 1979; Binswanger and Rosenzweig 1986; Dong and Dow 1993; Frisvold 1994; Raghbendra *et al*. 2000) [13, 5, 7, 11, 13, 23]. In more dynamic zones, the inverse link had ceased to exist (Chadha 1978) [8]. Ghose (1979) [14] contended that technical backwardness is a necessary prerequisite for the occurrence of the inverse relationship phenomena, suggesting that the inverse relationship will eventually disappear as technology develops. In a similar vein, Deolalikar (1981) [10] noted that in India, the inverse size productivity connection can be rejected at higher levels of agricultural technology but cannot be dismissed at lower levels. Foster and Rosenzweig (2010) [35] using plot level panel data (Over the span 1999-2008) and secondary data from NCAER, and using a model incorporating supervision costs, risks, credit market imperfections and scale economies associated with mechanisations, reported that small-scale farming is inefficient in India. Bhat and Bhat (2014) [6] found a non-linear relationship between farm size and productivity efficiency in Indian agriculture. Deininger, Jin, Liu, and Singh (2015) [9] found that the inverse relationship between farm size and productivity weakened over time in rural India, possibly due to better functioning labor markets and increased use of machinery. Sarthak and Mishra (2015) [27] finds an inverse relationship between farm size and productivity in Indian agriculture, even after controlling for various factors. Smallholders have greater productivity but low returns, thus raise sustainability concerns of their livelihoods. Smaller farms in India tend to use land more intensively, with higher output per hectare, due to regional

variations in fertility and labor supply. The inverse relationship between farm size and output per hectare is explained by regional variations in fertility and labor supply. Larger farms produce more output per hectare with less labor per hectare due to relative abundance of family labor on small farms (Newell, Pandya, and Symons 1997) [22]

In contrast, Hanumantha Rao (1975) [17] and Subbarao (1982) [33] found a positive correlation between farm size and production, which they attributed to larger farms' greater utilization of fertilizer and other expensive inputs. Smaller farms have higher land productivity in the short term, but land productivity tends to decline over time (Dyer 1997, Havnevik and Skarstein 1997) [12, 18]. Dyer (1997) [12], and Havnevik & Skarstein (1997) [18] contend that the over-intense cultivation of the land required to maintain labor productivity is the cause of this long-term decline in land productivity. Because smaller farms lack the resources to invest in maintaining soil fertility, soil productivity eventually runs out and land productivity declines as more and more people depend on the same small amount of farmland for their survival. Hazell (2011) [19] offers a similar justification, arguing that as nations grow, many of the benefits enjoyed by smallholders vanish.

Several case studies have been conducted to explore the relationship between farm size and productivity in different regions of the world. These studies provide important insights into the context-specific nature of the farm size-productivity relationship. Some studies have focused on Asia and Africa, where they found an inverse relationship between farm size and land productivity. Other studies have examined farm size productivity in more developed regions, such as Europe and North America, and found mixed results. Despite the ongoing debate, it is clear that the relationship between farm size and productivity is not a simple one. It is influenced by a range of factors including management input, human resources, technology adoption, and external institutions.

Conclusion

The debate on the relationship between farm size and productivity continues to be a topic of interest among researchers and policymakers. The literature on the farm size productivity debate is extensive and encompasses various theories and empirical studies. Critiques of the farm size-productivity relationship suggest that there may be other factors that contribute to variations in productivity, such as management input, human resources, and external institutions. These factors may have a greater impact on productivity within farm size groups rather than between farm size groups. Furthermore, the use of labor-intensive methods by small farms instead of capital-intensive machinery may contribute to their higher land productivity. Overall, the literature on the farm size productivity debate suggests that there is no one-size-fits-all answer. The relationship between farm size and productivity is complex and varies across different contexts.

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