

The Effects of Structural Transformation of the Indian Economy on the Land Use Pattern

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Due to high density of population the per capita availability of land in India is comparatively less than the rest of the world. As a result, issues concerning the effective and efficient use of scarce land resources are becoming increasingly important in the Indian context. Importance of agriculture in the economy has been declining in terms of the sector's share in GDP. On the other hand, the importance of the service sector is rapidly growing. Urbanisation has also increased significantly. Given these trends, it is quite possible that the land-use pattern in India has also been changing over the years in response to the structural changes that its economy has been going through. With this possibility in mind, the paper aims to examine whether changes in sectoral composition of the economy are reflected in the country's land use pattern also. Further, it explores if changes in the sectoral land shares have any correspondence with comparative sectoral land productivity trends. Data on Gross Value Added (GVA) and Land -Use Pattern, accessed from relevant websites of the Government of India have first been processed by computing ratios and percentage, and drawing trend lines. Further, econometric methods have been used to estimate

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annual compound growth rates. Results show that agriculture has been able to sustain overall growth, including an increase in food-grain production, despite stagnations in its land share. Non-agricultural sectors have been able to claim increasing shares of land from the reduction of barren, unculturable, and cultivable wastelands. But the important point to note here is that the land-share of non-agriculture has been increasing not at the expense of agriculture but from progressively bringing to use lands which were previously not under any economic use. This is a positive development in economic use of the country's limited land resource.

Keywords: Land use pattern; structural change; partial land productivity; food security.

1. INTRODUCTION

Land as a resource, being virtually inelastic in total supply, ought to be used most efficiently and sustainably. Land use pattern gives us the break up in which available land is being utilised for various alternative purposes. In the course of economic advancement, extensively land using agriculture usually gives way to manufacturing and services in which land loses its primacy as a factor of production but gains in terms of its productivity as it is combined with far higher doses of physical and human capital in the production process. These dynamics of development process naturally impact the land use pattern too [1]. The present paper juxtaposes sectoral transformation of the Indian economy with the changing land use pattern in the country during her post-independence developmental journey beginning in 1951 with the launching of her First Five Year Plan. The exercise has been motivated by the question whether intersectoral land allocation has been in accordance with cross-sectoral relative land productivity.

As an economy develops, different sectors' shares in the GDP and the workforce of the economy altering transforming its structural composition. Typically, the transformation is characterised by transfer of domination from agriculture to manufacturing and eventually to service sector in course of the economy emerging from an underdeveloped one to a developed one [2,3,4,5,6]. Structural transformation has been the driving force behind the growth of Asia, leading to the services sector emerging as both the primary employer and the sector with the highest output share [7] The manifestations of structural transformation in India have however deviated somewhat from the standard path [8,9]. In 1950, India's economic structure closely resembled those of Great Britain, Germany, the United States, Italy, and Japan at their respective beginnings of modern economic growth. Agriculture then accounted for 60% of GDP, industry contributed 13%, and

services constituted 27% of India's GDP. The corresponding shares of 75% of agriculture, 11% of industry and 16% of services in work force mirrored those of the United States in 1841 and Japan in 1880 [10]. India's structural transformation of income has been greater than experienced in developed countries, with the share of agriculture declining from around 60% in 1950-51 to 36.38% in 1983 and further declining to 14% by 2010-11 [11]. However, deviating from the standard model where industrialization typically precedes service sector expansion, India leap-frogged from a predominantly agricultural economy to one dominated by service sector without industry ever popping up as the major component. Despite India's conscious effort to industrialise rapidly from her Second Five Year Plan (1956-61) onwards, manufacturing could never grow up to the position of the sector of dominance in the economy. As the Indian economy shifted to a higher growth trajectory in the last two decades of the twentieth century, the growth process was primarily propelled by expansion of the services [9,12]. This service sector led growth owes much to the emergence of Information Technology and Business Process Outsourcing (IT-BPO) as growth propellers, of which India took full advantage of with its pool of suitably educated manpower [13]. Hence, the story of structural transformation of the Indian economy has to be viewed as one of transition from agricultural to a non-agricultural (comprising of both industries and services) one, rather than the typical three phased change from agricultural to industrial, and then to services-dominated structure.

"Land use" encompasses human activities that alter the land's cover, including habitation, protected areas, and agriculture, while "land cover" refers to natural vegetation types influenced by climate and landforms, which can also be impacted by human actions. Examples include forests, tundra, savannahs, deserts, and steppe, with further breakdowns into specific plant communities [14]. Land use patterns in

various regions of India have developed due to factors like physical land characteristics, institutional frameworks, available resources, and economic development aspects. Changes in these patterns are influenced by urbanization, population growth, land values, agricultural practices, non-agricultural activities, and public services [15,16,17]. India's land use pattern has shifted from agriculture to non-agricultural uses, posing challenges for food security and agricultural sustainability [18]. However, there has been a rise in fallow lands in India as a result of heightened variability in precipitation and irrigation water, coupled with limited mechanization. This trend has the potential to improve agricultural production and enhance food security, especially benefiting impoverished and marginalized farmers [19].

In terms of land area, India is the 7th largest country of the world. Yet, as India has the largest population in the world, it has a very high density of population with 477 people per square kilometre [20]. This implies that per capita availability of land in India is less than in the rest of the world. With relative scarcity of land, the issue of effective and efficient use of land assumes greater importance here. With the concerns for efficient allocation and effective utilisation of the land resource of the country, the present paper examines the correspondence between inter-sectoral land use pattern and sector-wise structural changes of the Indian economy. The underlying research question is whether intersectoral land allocation has been in accordance with cross-sectoral relative land productivity [21].

The specific objectives pursued in the paper have been formulated as to (a) examine the trend of land-use patterns in India since 1951, (b) examine the correspondence between the sector-wise composition of Gross Value Added (GVA) and the inter-sectoral land-use pattern and (c) compute sector-wise land productivity and examine whether trends in sectoral land shares have correspondence with sectoral land productivity growth rates.

The paper has been organized into four sections. Section two delineates the materials and methods used in this study. Results and discussion are explained in section three, which is further subdivided into (a) structural changes of the Indian economy since 1951, the year in which India embarked upon an economic planning-based development strategy, (b) the

trends in India's land use patterns, (c) the correspondence between structural changes in the economy and trends in land use patterns, and (d) examines inter-sectoral land productivity trends to see if sectoral allocation of land resources in the country corresponds to relative productivity growth across the sectors. The broad findings of the entire exercise are summarized in the concluding section.

2. MATERIALS AND METHODS

Land-use statistics and sector-wise composition of gross value added (GVA)¹ at 2011-12 prices have been collected from the Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, and the Government of India [22,23].

Structural change in the Indian economy has been captured in terms of variations in broad sector-wise shares in gross value added (GVA) of India from 1951-52 to 2020-21. The correspondence between structural change and land-use patterns has been examined by comparing the sector-wise composition of GVA with the inter-sectoral land-use along the trend line for the period spanning 1951-52 to 2018-19. However, it was necessary to regrouped both sector-wise GVA and land-use categories, as the sectors of GVA do not exactly correspond to given land use categories. Sector-wise land use statistics are given in 9 categories of (a) Forest Area, (b) Area with Non-Agricultural Uses, (c) Barren and uncultivable land, (d) Permanent Pasture and Other Grazing Land, (e) Land under Miscellaneous Tree, Crops, etc., (f) Culturable Waste Land, (g) Fallow Land other than Current Fallows, (h) Current Fallows, and (i) Net Area Sown [22]². On the other hand, Gross Value-Added statistics are given in three broad categories of (i) Agriculture and its Allied, (ii) Manufacturing and (iii) Service sectors. To be able to match land-use categories and GVA sectors, both land use classification and the GVA break-ups have been reconstructed. The details of this reconstructions are outlined in Table 1.

¹ *Gross value added is defined as the value of gross output produced by a sector or industry less the value of intermediate consumption (i.e., products and services required in the production process) [21].*

² *Definition of these land use categories are given in the Appendix*

Table 1. Reclassification of Land Use Categories and Sectors of GVA

SL No.	Redefined Sectors	Land-use Categories	Corresponding Sector-wise Contribution to GVA
1	Agriculture (Excluding fishing)	Net sown area, Land under misc. tree crops and groves, and Permanent pastures and other grazing lands	GVA from Crops and Livestock
2	Non-agriculture (Including fishing)	Area with Non-Agricultural Uses (It includes area used for constructions, roads, railroads, and water, such as rivers and canals.)	GVA from Fishing, Mining and quarrying, Manufacturing, Construction, Electricity, gas, water supply, other utility services, Transport, storage, communication, services related to broadcasting, Trade, repair, hotels and restaurants, financial services, Real estate, ownership of dwellings, professional services, public administration and defence and other services
3	Forest	Forest area	GVA from Forestry and Logging
4	Economically inactive land	Barren and unculturable land, Culturable waste land, Fellow Lands other than Current fallows, and Current fallow land	

Trends in the structural composition of the economy and also of the land use patterns have been worked out using ratios and percentages which have been presented graphically against time.

For the purpose of examining whether trends in land shares correspond to sector-wise relative land productivity, partial land productivity (Y) of a sector has been defined as the sector's GVA per hectare of land under its use. Thus:

$$Y_i = \frac{GVA_i}{LU_i} \quad (1)$$

Where Y_i , GVA_i and LU_i represent partial land productivity, Gross Value Added and Land use by sector i . The suffix i takes values 1, 2 and 3 for Agriculture, Non-agriculture and Forestry respectively.

To formally analyse the overall growth rate of land productivity, a semi-log linear trend equation has been fitted to partial productivity of each sector. The equation has been specified as:

$$\ln Y_{it} = a + bt + u_t \quad (2)$$

Where, $t = 1, 2, 3, \dots, 68$, starting with 1951-52 as 1;

$i = 1, 2$ and 3 for agriculture, non-agriculture and forestry, respectively;

and u_t is the random disturbance term.

If the slope coefficient 'b' is statistically significant and positive, then productivity has been increasing at the exponential rate of b . On the other hand, if the coefficient is significant and negative, then productivity has been declining.

In any given year, partial land productivity will be seen as lower for agriculture, as it naturally uses relatively more land per unit of its GVA than by non-agriculture sectors. To be able to observe and compare the trends in partial land productivities across sectors, we therefore have constructed partial land productivity indices for each sector taking 1951–52 as the base year. This index (PI) for sector i in the year t has thus been calculated as per equation 3:

$$PI_{it} = \frac{Y_{it}}{Y_{i0}} * 100 \quad (3)$$

Where, i takes values 1, 2 and 3 for Agriculture, Non-agriculture and Forestry respectively and, t takes values 0 to 68, with 0 for 1951-52 and 68 for 2018-19.

3. RESULTS AND DISCUSSION

3.1 Structural Change of the Indian Economy Since 1951

As per Kuznets' stylized pattern of modern economic growth, in the course of growth of an economy there is a continuous decline in the contribution of agriculture to both the GDP and the workforce [4]. Concomitantly, the shares of industry, and later on, the shares of services also, steadily increase. The Indian economy after independence has shown the same broad pattern of structural change, albeit with a notable exception. In India though the shares of industry increase over the years, industry itself could never become the dominant sector. Instead, services enjoyed higher and faster growing shares than industry in both GDP and workforce [12].

The structural change in the Indian economy in terms of sector-wise shares in GVA are shown in Fig. 1. It clearly portrays the above-mentioned patterns emphasizing that India's growth process has been service driven. The service sector led growth can be seen as more pronounced in the post-liberalization period starting from the year 1992-93.

In the context of the present paper, it is instructive to look at the trends in the share in GVA of agriculture and non-agriculture, i.e., industry and services taken together. Fig. 2 shows that the share of non-agricultural sector in Gross Value Added (GVA) has steadily increased since the beginning of our reference period while that of agriculture sector concomitantly declined. Non-agriculture sector overtook agriculture in terms of its share in India's GVA way back in the mid-1960s. An observation of some interest emerging from the figure is that there was a small decline in the share of non-agriculture and corresponding rise in that of agriculture during 2020-21. This reversal can be attributed to the impact of COVID 19 pandemic and hence should be only temporary in nature.

3.2 Trend in the Land-use Pattern

In this section we examined trends in the land-use pattern in India from 1951-52 to 2018-19.

3.2.1 Trends in land use pattern as per nine-fold classification

Fig. 3 depicts the absolute trend of these 9-fold land-use categories in India from 1951-52 to

2018-19. Up until 1966-67, the trend of net area sown increased, but after that, the trend is nearly constant. This means that after the green revolution, crop land has been used more intensively. We observed two V-shaped trends in net area sown for the years 1986-88 and 2001-04, owing primarily to rainfall deficits in 1987-88 and 2002-03 [22]. As a result, farmers were forced to leave the land fallow and accordingly corresponding to net area sown, we have noticed two inverted V-shaped trends for current fallow land for the respective years.

Both the current fallow and fallow lands other than current fallows have declining trends till 1966-1967. Since then, lands under these two categories have been increasing somewhat though at a very slow rate. Non-agricultural land and forested land have had rising trends. On the other hand, barren and unculturable land, and culturable waste lands have been gradually shrinking.

3.2.2 Trends as per Redefined Land Use Categories

The above scheme of land use classification however does not correspond to sectoral classification of GVA. Hence, a reclassification of land use categories became necessary to relate sectoral shares of land and with those of GVA. The nine-fold land-use categories have been first regrouped into (A) land currently under economically active use comprising of net sown area, land under misc. tree crops and groves, permanent pastures and other grazing lands, forest area, and area with non-agricultural uses and (B) land currently not under economically active use comprising of barren and unculturable land, culturable waste land, fellow land other than current fallow, and current fallow land. The category (A) then has been redivided into new categories of Agricultural land use, Non-agricultural land use, and Forest land. We classified fishing as non-agriculture because fishing land is included in the MOSPI's reported land-use statistics as non-agricultural uses. The GVA data similarly have been regrouped into GVA from agriculture and allied sectors excluding fishery, GVA from non-agricultural sectors and GVA from forestry.

Land used by re-grouped categories are presented in Fig. 4. Land under agricultural use increased up to 1964-65. Since then, land under agricultural use remained more or less constant in the rest of the century. After 2000 land under agricultural use showed a marginal decline.

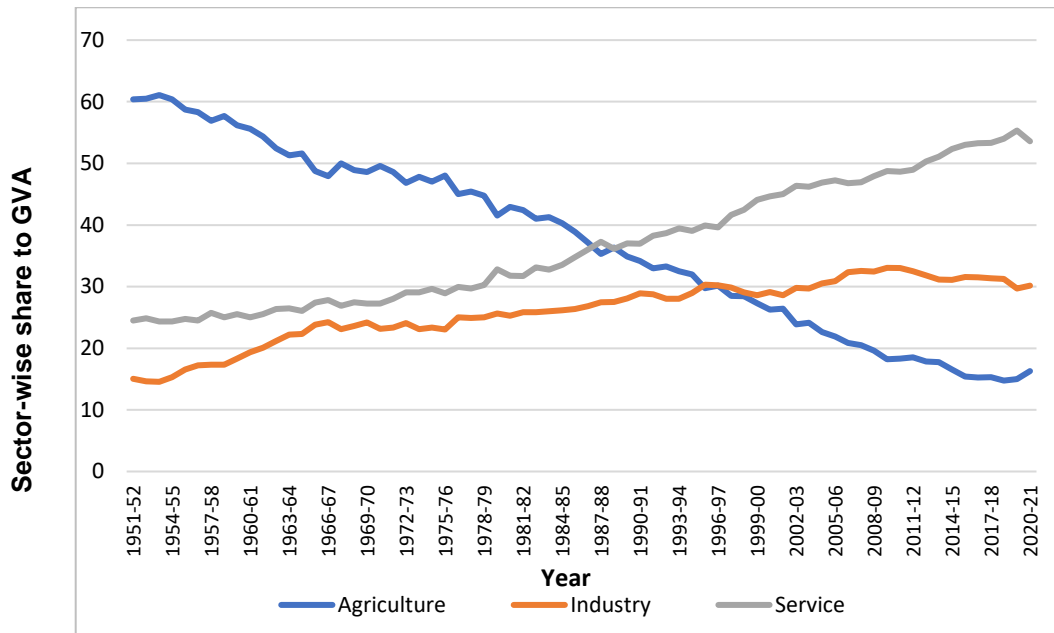


Fig. 1. Trends in shares of sectors in India's GVA from 1951-52 to 2020-21

Source: Author's construction using data from Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, & Government of India. Annual Report on National Accounts Statistics; 2022. Available from: <https://www.mospi.gov.in/download-reports>

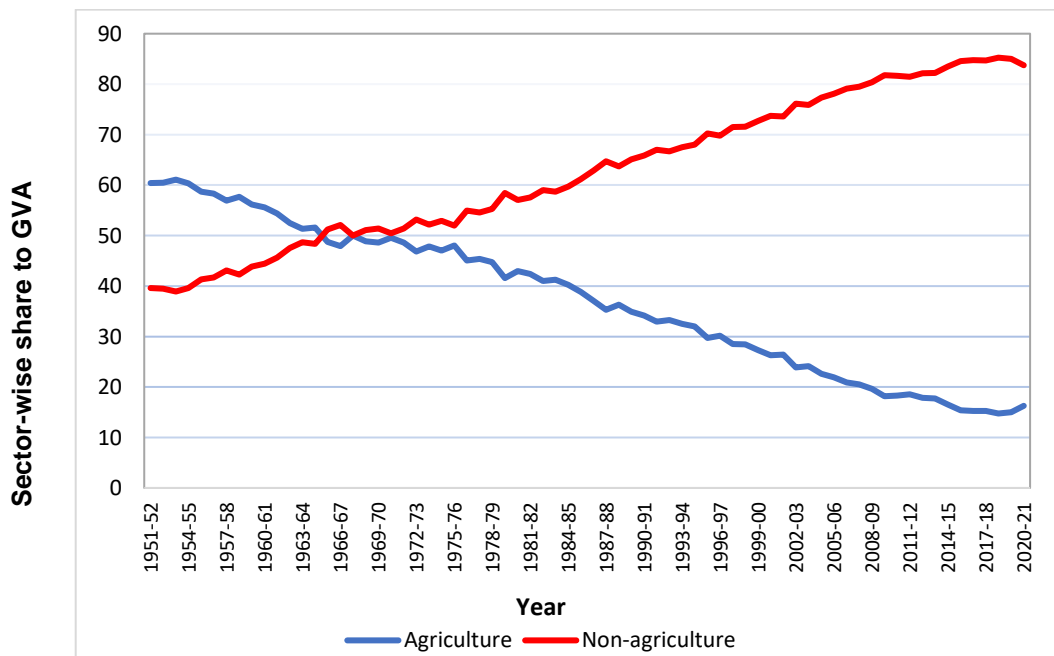


Fig. 2. Trends in Shares of Agriculture and Non-agriculture Sectors in GVA of India from 1951-52 to 2020-21

Source: Author's construction using data from Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, & Government of India. Annual Report on National Accounts Statistics; 2022. Available from: <https://www.mospi.gov.in/download-reports>

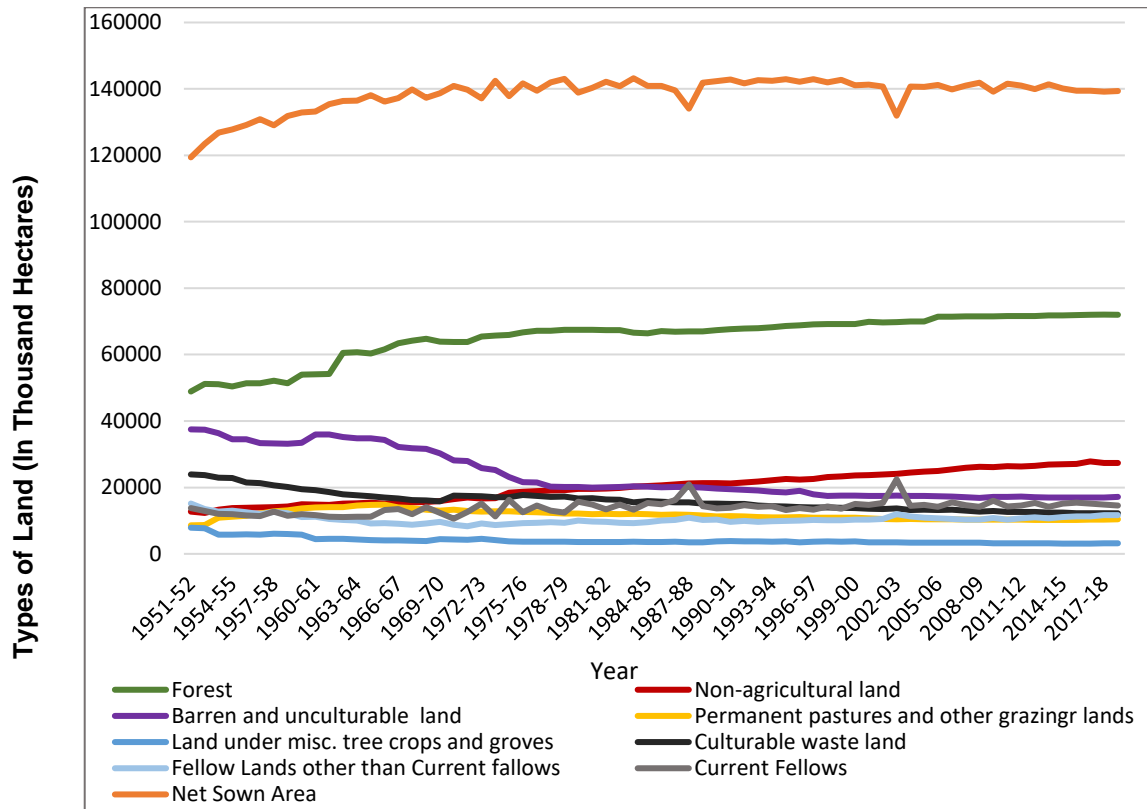


Fig. 3. Land-use Pattern in India from 1951-52 to 2018-19

Source: Author's construction using data from Government of India. Land-use Statistics at a Glance 2009-10 To 2018-19. Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture and Farmers Welfare. Directorate of Economics and Statistics; 2021. Available from: https://eands.dacnet.nic.in/LUS_2000_2005.htm

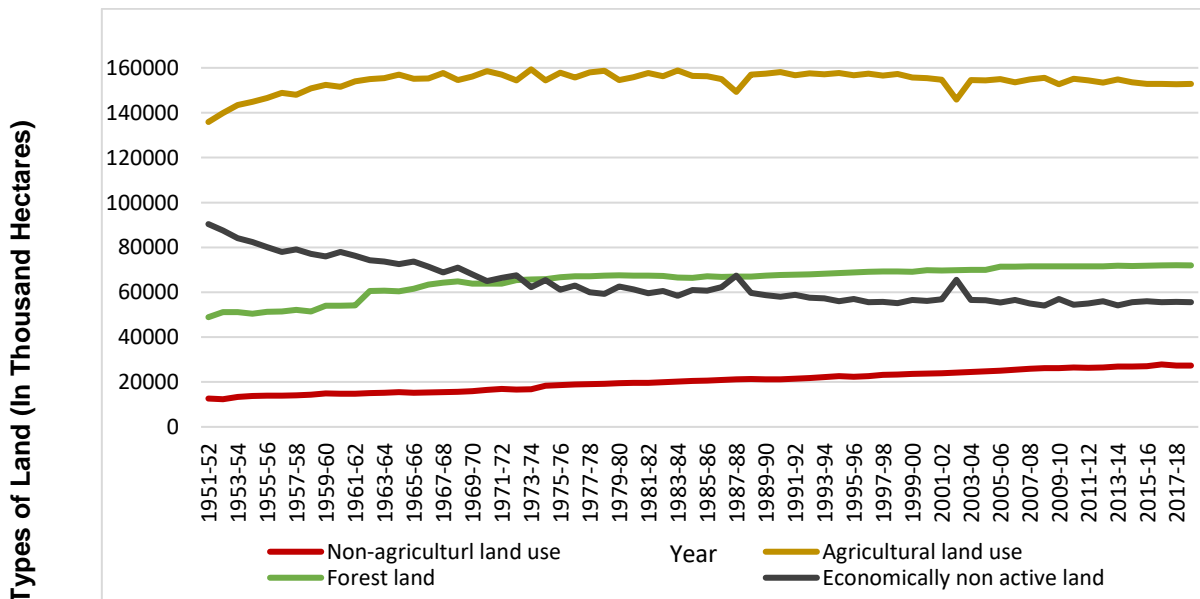


Fig. 4. Land under Economically Active and Inactive Categories in India from 1951 to 2018

Source: Author's construction using data from Government of India. Land-use Statistics at a Glance 2009-10 To 2018-19. Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture and Farmers Welfare. Directorate of Economics and Statistics; 2021. Available from: https://eands.dacnet.nic.in/LUS_2000_2005.htm

Throughout the entire period land under non-agricultural activities steadily expanded in a linear fashion. On the other hand, the economically inactive land, comprising of barren and unculturable land, culturable waste land and fallow land, declined steadily over the years. Clearly, economically inactive land has been progressively brought under economic use, which accounts for the rise in land under non-agricultural use despite no significant fall in land used in agriculture.

3.3 Correspondence Between Sectoral Land-use and Sectoral Gross Value Addition (GVA)

In the previous section it has been stated that land used by agriculture increased up to 1964 but stagnated and eventually declined marginally in the subsequent period. Does it imply that land shortage constrained agricultural growth in the post 1964 period? Fig. 5 suggests that it was not the case. Agricultural GVA continued to increase steadily though land under agriculture had stopped increasing after 1964³.

Continued growth of agricultural GVA despite stagnancy in land used by the sector has been explained in the literature by growth of productivity in the sector. In the period up to 1964, which corresponds roughly to the pre-Green Revolution period, growth in agricultural production was driven more by area expansion than yield growth.

After the advent of the Green Revolution in the later part of 1960s, growth in agricultural production has been driven by adoption and spread of land augmenting technological progress which manifested in increase in both crop-yields and cropping intensity per unit of land [24]. After 2000, growth in agricultural GVA, despite a mild decrease in land used by the sector, has been sustained by several new developments including shift in the composition of output in favour of higher value farm products of horticulture and livestock sub-sectors, application of genetically modified varieties and adoption of other land productivity enhancing practices [25,26].

³ The annual compound growth rate of agriculture's GVA was 2.57% for the period of 1951-52 to 1964-65, 3.01% for the period of 1965-66 to 1999-00 and 3.46% for the period of 2000-01 to 2018-19.

Notably, food-grain production has consistently demonstrated an upward trajectory, dispelling concerns about the compromise of the country's food security resulting from stagnation in agricultural land usage [27]. Fig. 6 illustrates the trends in foodgrain production (using a three-year moving average) and the net sown area in India. The figure highlights a notable trend in India's agricultural landscape, emphasizing that the country's foodgrain production has consistently risen over the years. This positive trajectory is noteworthy, particularly considering that the net sown area has remained relatively stagnant since the mid-1960s. Despite the limited expansion of cultivated land, the sustained growth in foodgrain production suggests an improvement in agricultural efficiency, technology adoption, or other factors contributing to increased productivity. This resilience in foodgrain production is a key observation, showcasing the ability of the agricultural sector to enhance output despite constraints in land availability.

Fig. 7 depicts the relationship between non-agricultural land use and non-agricultural GVA. Land used in the non-agriculture sector had a slower linear trend, while the value added by the non-agriculture sector had been rising much faster and exponentially. This means that the total value addition in the non-agriculture sector has increased due to both increased land use and also a rapid rise in productivity.

Fig. 8 represents the correspondence between forest GVA and forest land. Up to the mid-1970s forest land and GVA from forestry both had a rising trend. Since then, forest land continued to expand but at a much slower rate. GVA of the forestry sector during this period fluctuated without a distinct long-term trend.

3.4 Inter-Sectoral Land Productivity in India

Economic common sense suggests that the sectors where land productivity is high and growing faster should get progressively greater share of total available land. To examine whether the allocation of land has aligned with the relative sector-wise land productivity, we have calculated inter-sectorally comparable indices of sectoral partial land productivities which are presented in Fig. 9. The figure shows that productivity of non-agricultural land has been increasing the fastest over the years. Indeed, it has been increasing

exponentially since 1980. Productivity of agriculture has also been rising but at a lower rate and in a nearly linear fashion. On the other hand, partial land productivity of forests has remained more or less stagnant.

To estimate the growth rates of partial land productivities of the sectors over the entire period from 1951 to 2019, semi-log linear trend equations have been fitted to the series of partial

land productivities of the sectors. The results are presented in Table 2.

In contrast to partial land productivity of non-agricultural sectors growing at the annual compound rate of 4.72 percent, the growth rate for agriculture has been only 2.75 percent per annum. With the annual compound growth rate of merely 0.12, partial productivity of forest land has been practically stagnant.

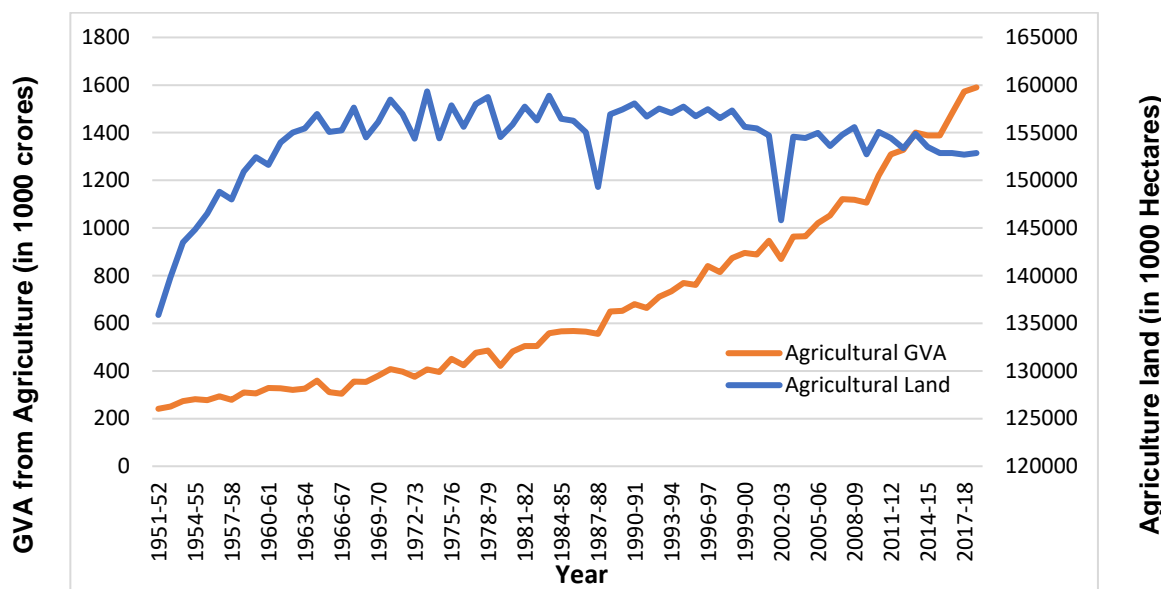


Fig. 5. Correspondence between Agricultural land and Agricultural GVA in India from 1951-52 to 2018-19

Source: Author's construction using data from Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, & Government of India. Annual Report on National Accounts Statistics; 2022. Available from: <https://www.mospi.gov.in/download-reports> & Government of India. Land-use Statistics at a Glance 2009-10 To 2018-19. Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture and Farmers Welfare. Directorate of Economics and Statistics; 2021. Available from: https://eands.dacnet.nic.in/LUS_2000_2005.htm
 Note: Agricultural GVA figures are in 2011-12 prices.

Table 2. Exponential growth rate of partial land productivity of different sectors in India over 1951-52 - 2018-19

Sectors	Agriculture	Non-agricultural	Forest
Exponential Growth rate (in %)	2.71 (2.75)	4.61 (4.72)	0.12 (0.12)
t-value	57.00	50.65	2.92
p-value	0.000	0.000	0.005
R Square	0.9801	0.9749	0.1146

Note: the number within () is the corresponding annual compound growth rate calculated using the formula $r = eb - 1$, where b is the estimated exponential growth rate using annual data
 Source: Author's calculation

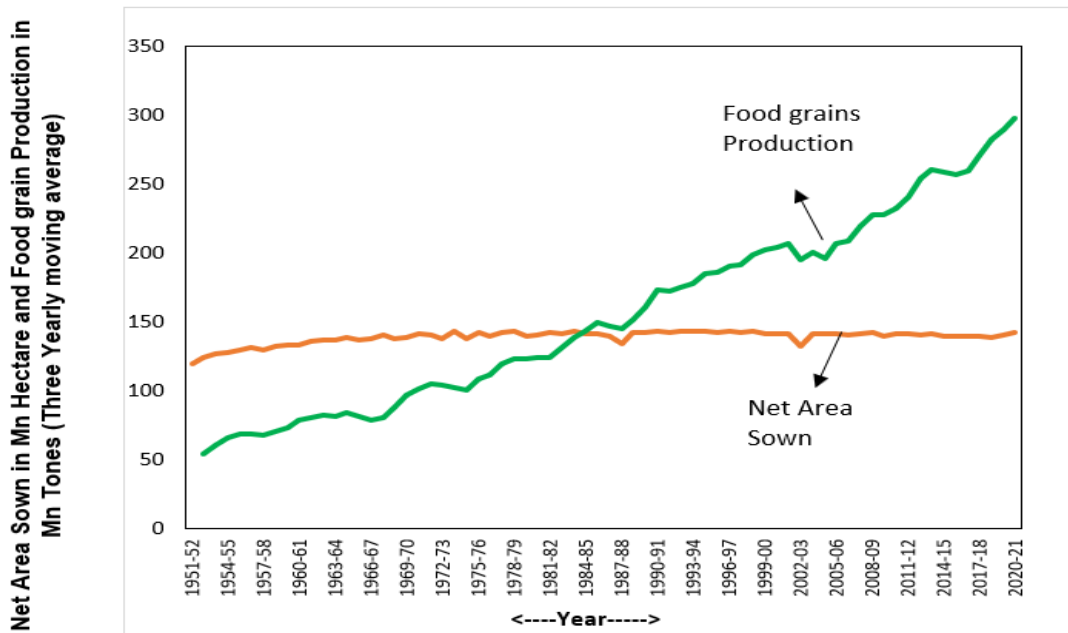


Fig. 6. Trends in Foodgrain Production and Net Sown Area in India from 1951-52 to 2020-21

Source: Author's construction using data from Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, & Government of India. Agricultural Statistics at a Glance 2021; 2022. Available from: https://eands.dacnet.nic.in/latest_2006.htm & <https://www.indiastat.com/table/agriculture/area-production-yield-foodgrains-oilseeds-commerci/1347703>

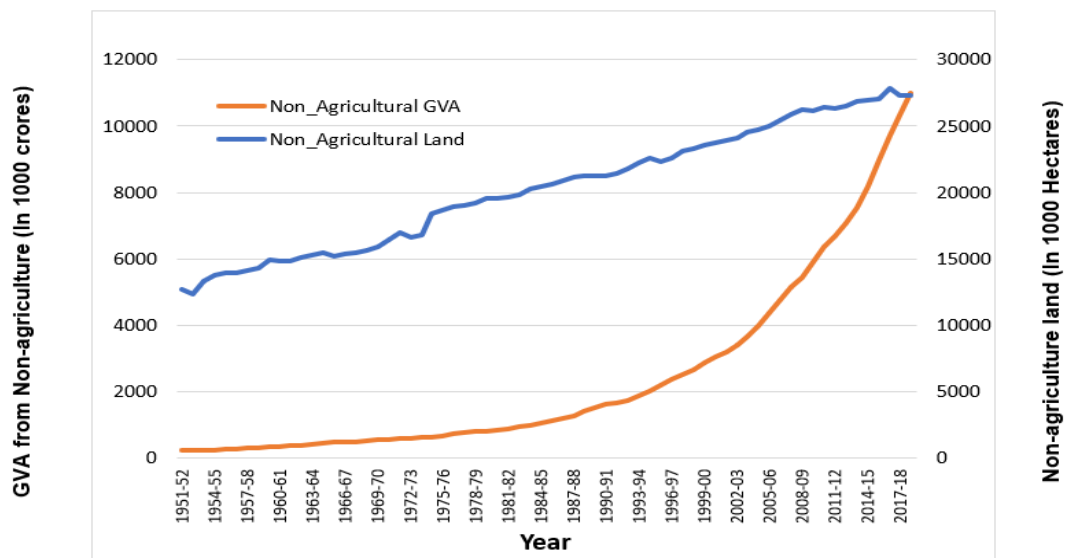


Fig. 7. Correspondence between Non-agricultural land and Non-Agricultural GVA in India from 1951-52 to 2018-19

Source: Author's construction using data from Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, & Government of India. Annual Report on National Accounts Statistics; 2022. Available from: <https://www.mospi.gov.in/download-reports> & Government of India. Land-use Statistics at a Glance 2009-10 To 2018-19. Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture and Farmers Welfare. Directorate of Economics and Statistics; 2021. Available from: https://eands.dacnet.nic.in/LUS_2000_2005.htm Note: GVA data are in constant 2011-12 prices.

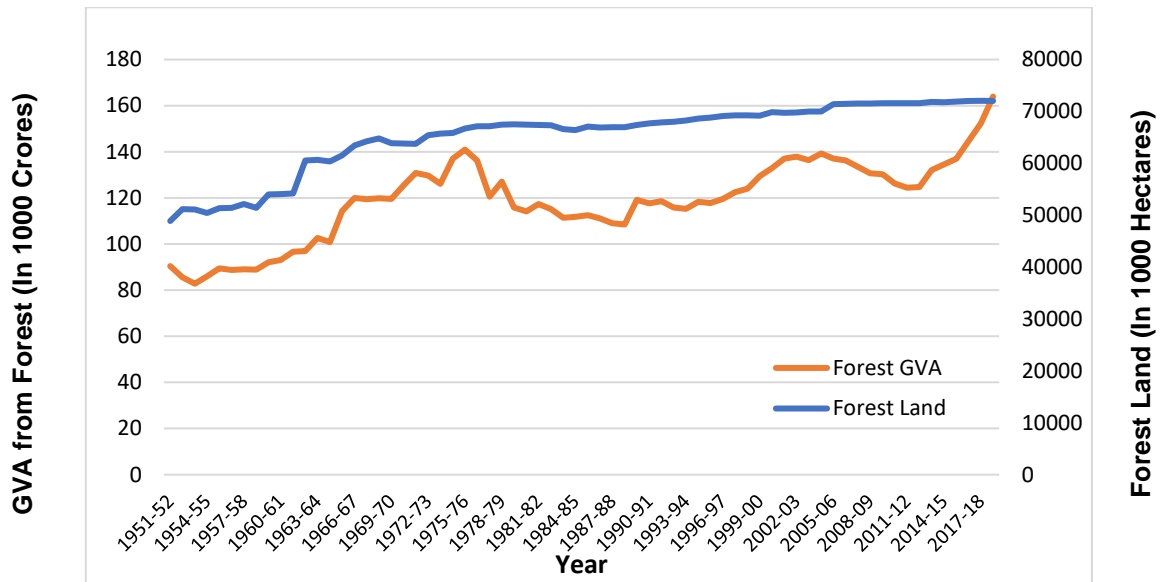


Fig. 8. Correspondence between Forest land and Forest GVA in India from 1951-52 to 2018-19

Source: Author's construction using data from Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, & Government of India. Annual Report on National Accounts Statistics; 2022. Available from: <https://www.mospi.gov.in/download-reports> & Government of India. Land-use Statistics at a Glance 2009-10 To 2018-19. Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture and Farmers Welfare. Directorate of Economics and Statistics; 2021. Available from: https://eands.dacnet.nic.in/LUS_2000_2005.htm
 Note: GVA data are in constant 2011-12 prices.

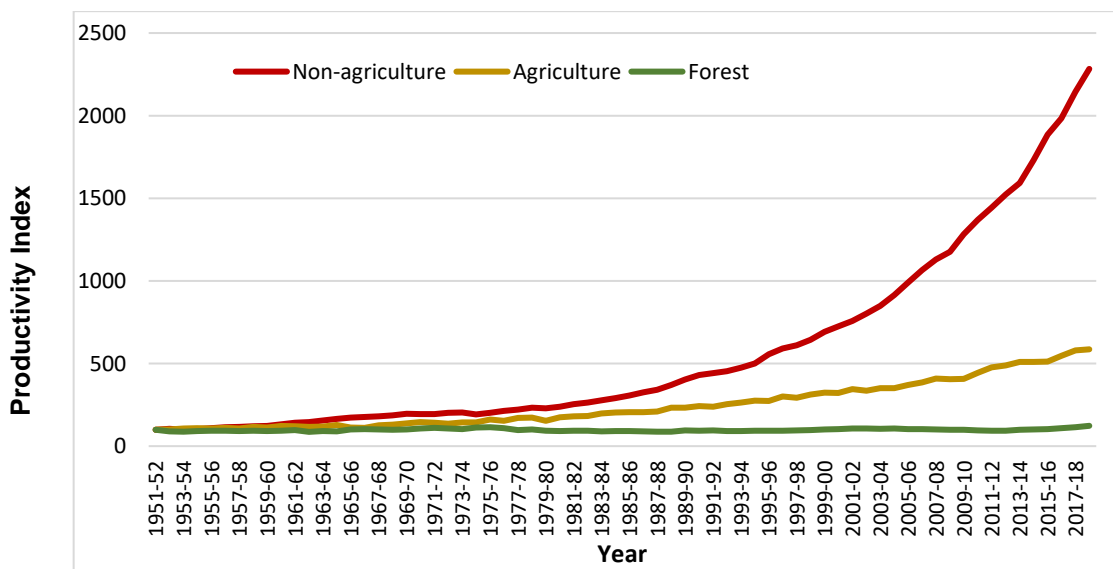


Fig. 9. Trend of Sector-wise partial land productivity indices in India

Source: Author's construction using data from Directorate of Economics and Statistics, Ministry of Statistics and Programme Implementation (MOSPI), Ministry of Agriculture and Farmers Welfare, & Government of India. Annual Report on National Accounts Statistics; 2022. Available from: <https://www.mospi.gov.in/download-reports> & Government of India. Land-use Statistics at a Glance 2009-10 To 2018-19. Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture and Farmers Welfare. Directorate of Economics and Statistics; 2021. Available from: https://eands.dacnet.nic.in/LUS_2000_2005.htm

Thus, partial land productivity in the non-agriculture sector has grown almost twice as fast as that of agriculture. Our observation in the previous section that the non-agriculture sector has been steadily expanding its land use, while land use in agriculture stagnated since the mid-1960s, goes to show that relatively more productive sectors are getting greater shares of land. In brief, change in land use pattern in India has been reflective of efficiency of use of land by the different sectors.

4. CONCLUSION

The agricultural sector's share in gross value added in India has decreased over time, while the shares of industry and services have increased. The service sector has emerged as the dominant sector since 1991, when India embarked upon wide ranging market oriented economic reforms. These changes in sectoral composition of the economy have gone hand in hand with changes in the land use pattern. Non-agricultural land use has been going up in tune with the growing importance of the industry and services in the economy. In this context, a concern may naturally arise regarding adequacy of land availability for agriculture to perform its traditional yet vital role of ensuring the country's food security. Above-reported analysis shows that the land-share of non-agriculture has been increasing not at the expense of agriculture but from progressively bringing to use land which were previously not under any economic use. This is a positive development in economic use of the country's limited land resource. Further, growths in agricultural GVA and the country's foodgrain production have been sustained despite the stagnancy in total land used by agriculture. This has been possible because of steady growth of agricultural productivity coming initially from adoption and spread of yield and cropping intensity enhancing Green Revolution technologies [28], and later on from diversification towards higher value products [29] and adoption of next generation technologies such as genetically modified variety of BT cotton [30].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

- a) **Forest Area:** This includes all land classified as forest under any legal enactment or administered as forest, whether State-owned or privately owned, and whether wooded or kept as potential forest land. The area of crops grown in the forest, as well as grazing lands or areas open to grazing within the forest, are considered to be part of the "forest area."
- b) **Area with Non-Agricultural Uses:** This category comprises all land-used for purposes other than agriculture, including area used for constructions, roads, railroads, and water, such as rivers and canals.
- c) **Barren and uncultivable land:** This covers all territory covered by mountains, deserts, and so forth. Unculturable land is land that cannot be brought under cultivation except at excessive cost, whether it is in isolated blocks or inside farmed properties.
- d) **Permanent Pasture and Other Grazing Land:** All grazing land, whether permanent pasture/meadows or not, is included in this category. This category includes village common grazing land.
- e) **Land under Miscellaneous Tree Crops, etc.:** This category comprises all cultivable land that is not included in the 'Net area sown' but is used for agricultural purposes. This category includes land under casuring trees, thatching grasses, bamboo plants, and other groves for fuel, etc. that are not categorised as orchards.
- f) **Culturable Waste Land:** This comprises land that has been accessible for cultivation, whether taken up or not, but has not been farmed in the past five years or more in succession, including the present year, for whatever cause. Such land may be fallow or covered with bushes and jungles that are not used. They might be accessible or inaccessible, and they can be found in solitary blocks or inside farmed estates.
- g) **Fallow Land other than Current Fallows:** It includes all land that was taken up for cultivation but is now temporarily out of cultivation for a period of one year or more.
- h) **Current Fallows:** This is cropped land that has been left fallow for the current year.
- i) **Net Area Sown:** This is the total area sown with crops and orchards. Areas sowed more than once in the same year are only counted once.

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