

# How unequal is rural Punjab? Empirical evidence from spatial income distribution

Bishwa Bhaskar Choudhary and Priyanka Singh\*

Department of Economics and Sociology, Punjab Agricultural University, Ludhiana 141 004, India

**The present study assesses the inequality arising from variation of economic opportunity across agro-climatic zones of Punjab, India. The analysis indicates that the poor in the state tend to diversify their income portfolio towards wages and salaries, and livestock sources. Crop farming is the major income source of the households; yet it contributes maximum (75.8%) in total inequality and is inequality triggering in its effect. While livestock and, wages and salaries are the potential sources to bridge the inequality gap in the entire state, non-farm business sources would be effective in the central and western zones of Punjab. The result of Theil index emphasized within-group inequality as the principal contributor in total inequality across agro-climatic zones and districts. Therefore, policy intervention at individual district and zonal levels would be more imperative for correcting spatial imbalances in income distribution among farm households of the state.**

**Keywords:** Agro-climatic zones, empirical evidence, income inequality, rural households, Theil index.

PUNJAB has a history of outstanding achievement in agricultural development in India. An ideal combination of environmental, institutional and technological factors resulted into the transformation of agriculture and rural economy in the state, and converted Punjab into the 'Granary of India'<sup>1,2</sup>. Despite significant economic growth and a visible structural transformation of the state economy over time, agriculture sector still contributes more than 26% of the gross state value added (GSVA) at constant prices in 2016–17 and engages around 36% workforce<sup>3</sup>.

The spectacular growth in agriculture over a high base in the recent past has trickled down and resulted into the highest average monthly income per agricultural household (INR 18,059 per month) in Punjab among all Indian states in 2012–13; it is above two and half times that of the national average<sup>4</sup>. The agricultural growth in Punjab was termed as size-neutral as most of the farming households as well as agricultural labour households could reap the benefits of such growth. This is evident from a significant reduction in poverty in Punjab owing to such

growth. The strategy for inclusive growth requires policy instruments which can ensure fair distribution of income. The selection of such instruments hinges on an improved understanding of various components of household income and their inequality/equality inducing characteristics.

The diversification of income sources and its impact on income distribution have drawn serious attention across the globe<sup>5–7</sup> as well as in India<sup>8,9</sup>. While, the equalizing effect of income from livestock sources has been unanimously supported<sup>9–11</sup>, there is mixed evidence on the distributional impacts of non-farm income. Lanjouw and Shariff<sup>12</sup> considered non-farm sources to be neutral; however, the inequality triggering effect of non-farm sources has also been substantiated in a few studies of national interest<sup>8,9,13</sup>. Vatta and Sidhu<sup>14</sup>, and Pavithra and Vatta<sup>15</sup> have emphasized on equality smoothening effect of non-farm income in Indian Punjab.

The rural economy of Punjab has undergone structural transformation owing to the dynamic changes which have occurred in the state over time<sup>15</sup>. The continuously declining farm profitability and limited progress in crop diversification have seriously hit employment opportunity in the farm sector in Punjab<sup>16</sup>. Increasing incidence of landlessness, declining profitability from rice–wheat system, depleting groundwater and rise in the cost of crop cultivation are major factors pointing to the prevailing distress in the agriculture sector in recent times. These are inducing the agricultural households to resort to non-farm sector as an important alternative income source<sup>17,18</sup>. It is important to note here that between 2006–07 and 2011–12, rural workforce engaged in the primary sector in Punjab had reduced by 8%, while in the secondary sector it had increased by 11% (ref. 19).

Evidences from the existing literature indicated that most of the studies in the Indian context pertaining to income inequality of rural households and distributional consequences of income sources have been carried out for the country as a whole<sup>8,9,20</sup>. However, effective pro-poor growth policy prerequisites a clear understanding of regional composition of income earned by farm families and distributional impact of income sources. The present study has been carried out to gain insights about income inequality among agricultural households prevailing at various regional and districts levels in Punjab. We also assess the impact of regional variations in economic opportunity on income inequality in the state.

\*For correspondence. (e-mail: bishwa606@gmail.com)

**Materials and methods**

*Data*

The data pertaining to income of agricultural households in Punjab from various sources, viz. crop farming, livestock, wages and salaries, and non-farm business have been sourced from the 70th round Situation Assessment Survey (January 2013–December 2013) of the National Sample Survey Office, Ministry of Statistics and Programme Implementation (MOSPI), Government of India (GoI). The survey covered 725 rural agricultural households from 94 villages in Punjab. In the survey, an agricultural household was defined as that which received an income of more than INR 3000 from agricultural activities and had at least one member self-employed in agriculture, either in the principal status or in subsidiary status during the last 365 days. The four major income sources were crop farming, livestock, wages and salaries and non-farm business. Income from crop farming is from the cultivation of various seasonal and annual crops. Income from livestock is earned by a household from the sale of various products like milk, eggs and live animals. Wages and salaries are derived by various household members employed in labour outside their household – either in other’s fields or in non-farm enterprises. Income from wholesale and retail trade, manufacturing, transportation and storage, accommodation and food service, construction and other services is covered under non-farm business. Some households reporting unusual and high negative income from crops and livestock farming were removed from the dataset to avoid their possible influence on the estimates of our substantive interest.

**Analytical procedure**

Out of several available measures of inequality in the literature<sup>21</sup>, Gini coefficient and Theil index have been used here. Gini coefficient has been computed to explain the inequality across various regions and districts of Punjab. Following Kaditi and Nitsi<sup>22</sup>, vertical decomposition of inequality (Gini coefficient) was performed to assess the contribution of various income sources to total inequality. Apart from decomposing inequality by income source, horizontal decomposition of inequality into within and between regions was obtained by the Theil index, which provided information on how inequality arises from variation of economic opportunities across regions.

*Gini coefficient and vertical decomposition of inequality:* Following Lerman and Yitzhaki<sup>23</sup>, the Gini coefficient for total income inequality,  $G$ , was computed as follows

$$G = \sum_{k=1}^K S_k G_k R_k, \tag{1}$$

where  $S_k$  represents the share of source  $k$  in total income and reflects how important the income source is with respect to total income;  $G_k$  is the source Gini corresponding to the distribution of income from source  $k$  indicating equality/inequality of income distribution from a given income source, and  $R_k$  is the Gini correlation of income from source  $k$  with the distribution of total income indicating how a given income source is correlated to the total income of a household.

In eq. (1),

$$G_k = 2 \text{Cov}(Y_k, F_k) / \bar{Y}_k, \tag{2}$$

and

$$R_k = \text{Cov}(Y_k, F) / \text{Cov}(Y_k, F_k), \tag{3}$$

where  $\bar{Y}_k$  is the mean income from income source  $k$ ,  $\text{Cov}(Y_k, F_k)$  is the covariance between income component  $k$  and its cumulative distribution and  $\text{Cov}(Y_k, F)$  is the covariance between income component  $k$  and cumulative distribution of total income.

Further, using the Gini decomposition by income source, the effect of changes in a particular component on inequality can be estimated, holding income from all other sources constant. Assuming a change in each household’s income from source  $k$  equal to  $e_k$ , where  $e$  is close to 1, then the partial derivative of the Gini coefficient with respect to a percentage change  $e$  in source  $k$  will be

$$\frac{\partial G}{\partial e_k} = S_k (R_k G_k - G). \tag{4}$$

Then, the marginal effect of the income source relative to the overall Gini can be obtained by dividing eq. (4) by overall Gini coefficient ( $G$ ) as follows

$$\frac{\partial G / (\partial e_k)}{G} = \frac{S_k R_k G_k}{G} - S_k. \tag{5}$$

Following Kimhi *et al.*<sup>24</sup>, robustness of the marginal effect was examined using bootstrapping techniques.

*Theil index and horizontal decomposition of inequality:*

The Theil index is one of the two most widely applied inequality measures (the other being the Gini coefficient). The key advantage of Theil index is that, unlike the Gini coefficient, the total amount of inequality measured by it can be decomposed into two additive components of between-group and within-group inequality as

$$I = \sum_{m=1}^m \left[ \frac{N_m}{N} \right] \left( \frac{\bar{Y}_m}{\bar{Y}} \right) \ln \left( \frac{\bar{Y}_m}{\bar{Y}} \right) + \sum_{m=1}^m \left( \frac{N_m}{N} \right) \left( \frac{\bar{Y}_m}{\bar{Y}} \right) \text{Im}, \tag{6}$$

where  $m$  equals the number of groups (regions in the present case),  $N$  and  $N_m$  the total number of

**Table 1.** Sources of income of farm households by Income quintile

Quintile	Average income (INR/household)	Crop farming (%)	Livestock (%)	Wages and salaries (%)	Non-farm business (%)
Bottom	3,981	30.75	29.30	32.87	7.08
Second	10,061	48.23	24.96	21.41	5.4
Third	17,294	72.03	17.54	7.86	2.57
Fourth	29,072	71.43	16.42	8.59	3.57
Top	74,581	73.26	12.25	10.04	4.45
All	26,998	69.59	15.27	10.97	4.17

Source: Authors' estimates from NSSO data.

households and the number of households in group  $m$  respectively,  $Y_m$  the monthly income of a household in group  $m$  and  $\bar{Y}$  is the mean income of all households. The first and second terms in the eq. (6) represents between-group and within-group inequality respectively.

As a small number of households in the dataset had total or source as negative or zero and these numbers were not a significant proportion of the total sample, negative and zero values were replaced with very small positive value ( $e$ ) following Bellu and Liberati<sup>25</sup>. In this study,  $e$  is taken as  $10^{-10}$ . The analysis has been carried out using Stata/SE.

## Results and discussion

### *Household income composition across income quintiles*

We have examined the composition of household income across various sources such as crop farming, livestock, wages and salaries and non-farm business. The disparity in the contribution to income by various sources across income quintiles is pronounced (Table 1). It is worthwhile to note that wages and salaries is the major source of income for households in the bottom quintile, accounting for nearly 33% of their total income. Livestock and crop farming are the other major sources of income for these households.

Share of livestock in total income decreases on moving from the bottom to top quintile, while on the contrary, share of crop farming tends to be higher in the higher income quintile. The share of non-farm business in total income is marginal for all the income quintiles; however it is maximum (7.08%) for the bottom 20% of households. Overall, crop farming is a major income source for households, accounting for around 70% of total income. The pattern of income distribution indicates that the poor tend to diversify their income sources, while the rich specialize towards crop cultivation. The rising share of crop income from the bottom to top income quintile, and declining share of livestock, wages and salaries, and non-farm business income point towards the fact that income and employment opportunities in Punjab seem dependent

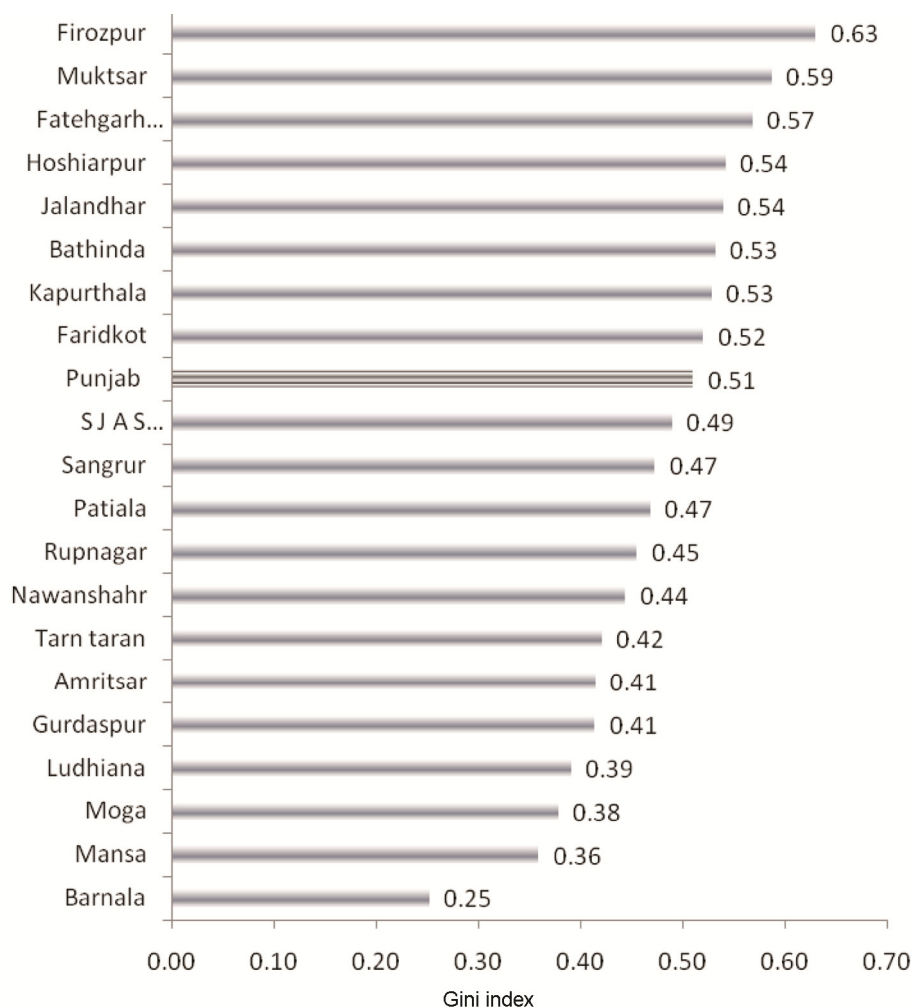
on land ownership. Large farmers may not prefer livestock as it is labour intensive. These trends also point towards the distress nature of wage work in the farm and non-farm sectors, and other business activities in the non-farm sector.

### *Inequality decomposition by income sources*

*Decomposing overall income inequality:* The Gini index of total household income in Punjab was estimated to be 0.51 (Figure 1), indicating relatively large inequality in income distribution of agricultural households in the state. Across districts, the least value of Gini coefficient in Barnala indicates that agricultural household income is the most evenly distributed there, while Ferozepur district shows the worst distribution with Gini coefficient of 0.62. It is important to note that, in the eight out of 20 districts (Figure 1), i.e. in 40% of the districts, income is more unevenly distributed than that of the whole state.

Table 2 depicts the decomposition result of Gini coefficient by sources of income of agricultural households for the state. It is worth mentioning here that, as not all the households earn from all the activities, therefore, zero income value from the sources magnified the component's Gini ( $G_k$ ) the Gini index of total income. The Gini for non-farm business ( $G_k$ ) is highest (0.964) followed by  $G_k$  that for wages and salaries. Figure 2 depicts the magnitude of the disproportionate income distribution along with 95% confidence interval from all the four income sources. It is interesting to note that, though, income from crop farming is most equally distributed (Table 2), yet it contributes maximum (75.8%) in total inequality as it is a major source of income ( $S_k = 0.696$ ). The high correlation of crop farming with total income ( $R_k = 0.935$ ), indicating that households which are above in the total income strata derive more income from cultivation of crops, also contributed its share in total inequality.

The lowest value of Gini correlation in the case of wages and salaries ( $R_k = 0.437$ ) indicates the biasness of the income source towards lower income quintile (as also evident from Table 1). As a result, this source has the potential to reduce overall income inequality. It is also



**Figure 1.** Gini index across districts in Punjab, India. Note: Fazilka and Pathankot have been carved out from Firozpur and Gurudaspur respectively, in 2011.

evident from Table 2 that crop farming is inequality-increasing in its effect; other factors remaining constant, 1% increase in income from crop cultivation, increases total inequality by 0.062%. Income from livestock and that from wages and salaries tend to significantly reduce income inequality in the state. There was no significant impact of non-farm business income on inequality amongst agricultural households in Punjab. Pavithra and Vatta<sup>15</sup> in their primary data-based study have also reported prevalence of high income inequality in Punjab with Gini coefficient of 0.52; however, they reported that income from non-farm activities decreases income inequality. Vatta and Sidhu<sup>14</sup> reported that non-farm sources reduce the overall income inequality in the state.

In light of this, it is important to mention that the incongruity in the findings reported here regarding the nature of impact of non-farm sources on inequality among households is mainly attributed to the differences in the concept of a household and consideration of activities under non-farm sources in earlier studies.

*Decomposition of overall income inequality by agro-climatic zones of Punjab:* Punjab with an area of 50,362 sq. km has diverse agro-climatic situations. The state has been divided into five agro-climatic zones on the basis of homogeneity, rainfall pattern, cropping pattern, etc. as: sub-mountain undulating zone, undulating plain zone, central plain zone, western plain zone and western zone (Figure 3 and Table 3)<sup>26</sup>. As the economic opportunity is largely influenced by prevalence of agro-climatic conditions in a region, understanding the regional component of income and inequality would be more policy-sensitive. Therefore, the present study further disentangles the income inequality by income sources across the various agro-climatic zones of Punjab.

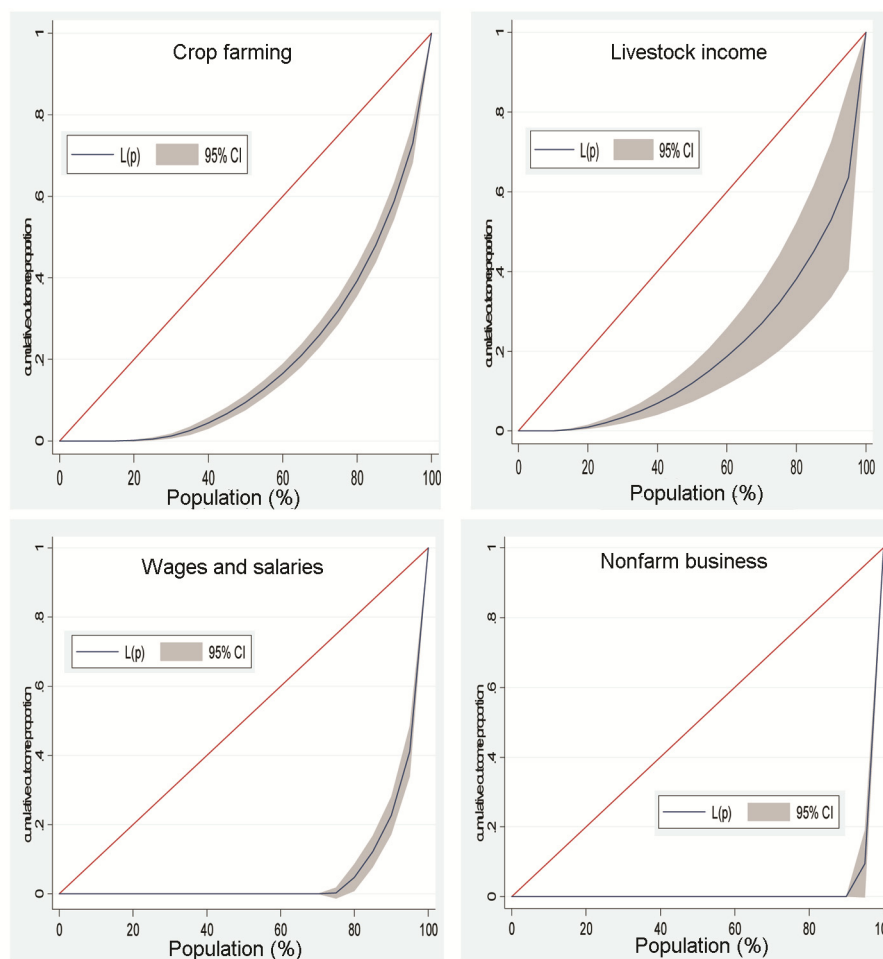
It is evident from Table 4 that income of households is more unevenly distributed in the western plain zone, and Gini index for the region (0.632) is higher than that of the whole state (0.517). Distribution of income among households is comparatively more equal in the central plain zone. Nevertheless, crop cultivation is the major

**Table 2.** Decomposition of inequality by sources of income

Source	Income share ( $S_k$ )	Source Gini ( $G_k$ )	Gini correlation ( $R_k$ )	Share in total Gini	Marginal contribution to Gini
Crop farming	0.696	0.602	0.935	0.758	0.062 (0.021)**
Livestock	0.153	0.606	0.650	0.116	-0.036 (0.010)*
Wage and salaries	0.110	0.878	0.437	0.082	-0.028 (0.005)*
Nonfarm business	0.042	0.964	0.566	0.044	0.002 (0.006)
Total income		0.517			

Source: Authors' estimates from NSSO data. Notes: Bootstrapped standard error with 50 replications in parentheses.

\*Significant @ 1%, \*\*Significant @ 5%.

**Figure 2.** Lorenz curves of income sources.

income source across all zones; a wide disparity exists among the share of other sources in the total income. Livestock has significant share in the total income in the western plain zone (31.7%), while in the sub-mountain undulating zone it contributes only 8% to the total income of the households. Income from wages and salaries is the second major source in the sub-mountain undulating zone and its contribution is nearly equal to livestock sources in the undulating plain zone of the state. Non-farm business is an important source of income after crop and livestock in the western plain zone. Further,

earnings from crop farming, with an exception in the western plain zone, contribute maximum to total income inequality and are significantly inequality-increasing in their effect across all the zones. Livestock has the highest share in Gini coefficient in the western plain zone and unlike in other zones, 1% increment in income from livestock sources, ceteris paribus, would significantly increase inequality by 0.086% in the region. Therefore, any effort to bridge the inequality gap in the region should not be livestock-oriented. Assuring fair wages and salaries would be an appreciable policy thrust

**Table 3.** Agro-climatic zones of Punjab, India

Agro-climatic zones	Districts covered	Major crops grown	Average rainfall (mm)	Cropping intensity (%)
Sub-mountain undulating zone	Gurdaspur and Hoshiarpur	Wheat, paddy, sugarcane	1000	177
Undulating plain zone	Rupnagar (Ropar), SBS Nagar (Nawanshahr) and Mohali	Wheat, paddy, sugarcane	1000	187
Central plain zone	Amritsar, Tarn Taran, Kapurthala, Jalandhar, Ludhiana, Fatehgarh Sahib, Sangrur and Patiala	Wheat, paddy	630–700	189
Western plain zone	Firozpur and Faridkot	Wheat, paddy, cotton	630–700	190
Western zone	Moga, Bathinda, Mansa, Muktsar, Sangrur and Barnala	Wheat, paddy, cotton	630–700	193

Source: Punjab Revenue<sup>26</sup>.



**Figure 3.** Agro-climatic zones of Punjab. Source: Punjab Revenue<sup>26</sup>.

for even distribution of income in all the regions as increase in income from this source has significant equalizing effect on income sharing among households across all the regions of Punjab. Promoting non-farm business in the central plain zone, western zone and undulating plain zone of the state would also be helpful in minimizing the uneven distribution of income in these regions.

*Decomposition of income inequality within and between agro-climatic zones and districts:* In this study, the Theil measure of inequality is decomposed as between- and within-group inequality. Table 5 clearly illustrates that the value of Theil index is more for ‘within’ the zone and district than the corresponding ‘between’ values for all the sources as well as total income. This indicates that

intra-zonal and intra-district inequality is the main contributor in total inequality in the zones and districts respectively. Therefore, policies aimed at the elimination of income differences between the various agro-climatic zones and districts would not be more meaningful. Orientation of efforts within a district and within a geographically aggregated district represented by agro-climatic zones would be more imperative for smoothening the income inequality of agricultural households in Punjab.

### Conclusion and policy implication

Improvement in income of agricultural households and its even distribution among them is the fundamental

**Table 4.** Decomposition of inequality by sources across agro-climatic zones

Agro-climatic zones	Source	Income share ( $S_k$ )	Source Gini ( $G_k$ )	Gini correlation ( $R_k$ )	Share in total Gini	Marginal contribution to Gini (%)
Central plain zone	Crop	0.721	0.594	0.927	0.805	0.084 (0.023)*
	Livestock	0.147	0.513	0.516	0.079	-0.068 (0.019)*
	Wages and salaries	0.112	0.891	0.484	0.098	-0.014 (0.005)*
	Nonfarm business	0.020	0.963	0.465	0.018	-0.002 (0.001)**
	Total income	0.493				
Western zone	Crop	0.753	0.599	0.959	0.868	0.114 (0.017)*
	Livestock	0.110	0.456	0.536	0.054	-0.056 (0.015)*
	Wages and salaries	0.092	0.867	0.276	0.044	-0.048 (0.008)*
	Nonfarm business	0.045	0.936	0.410	0.034	-0.010 (0.004)*
	Total income	0.499				
Sub-mountain undulating zone	Crop	0.716	0.616	0.940	0.829	0.113 (0.022)*
	Livestock	0.080	0.493	0.240	0.019	-0.061 (0.018)*
	Wages and salaries	0.164	0.786	0.415	0.107	-0.057 (0.007)*
	Nonfarm business	0.039	0.971	0.592	0.045	0.006 (0.011)
	Total income	0.500				
Undulating plain zone	Crop	0.589	0.649	0.878	0.668	0.079 (0.034)**
	Livestock	0.199	0.564	0.590	0.132	-0.067 (0.029)*
	Wages and salaries	0.188	0.872	0.573	0.187	-0.001 (0.032)
	Nonfarm business	0.025	0.958	0.294	0.014	-0.011 (0.004)*
	Total income	0.502				
Western plain zone	Crop	0.502	0.542	0.929	0.400	-0.102 (0.042)*
	Livestock	0.317	0.872	0.922	0.403	0.086 (0.034)**
	Wages and salaries	0.055	0.938	0.619	0.050	-0.005 (0.002)*
	Nonfarm business	0.127	0.949	0.771	0.147	0.020 (0.027)
	Total income	0.632				

Source: Authors' estimates from NSSO data. Notes: Bootstrapped standard error with 50 replications in parentheses.  
\*Significant @ 1%; \*\*Significant @5%.

**Table 5.** Theil index of inequality by agro-climatic zones

Source of income	Agro-climatic zones		Districts	
	Between	Within	Between	Within
Crop	0.011	0.669	0.029	0.650
Livestock	0.132	0.954	0.195	0.890
Wages and salaries	0.020	1.837	0.206	1.650
Nonfarm business	0.333	2.837	0.781	2.388
Total income	0.012	0.509	0.036	0.484

Source: Authors' estimates from NSSO data.

objective of any policy intervention in agriculture. The present study estimated the inequality prevailing among agricultural households in Punjab, and analysed the impact of various sources of income on income inequality in the state. It further provides detailed comparison and decomposition of inequality at different levels of aggregation, viz. agro-climatic zones and districts that would be imperative from a policy perspective.

Crops cultivation is the major source of income in almost all quintiles; however, the bottom 20% of the population derives income largely from wages and salaries. Also, being the major income source and due to its high correlation with total income, earnings from crops contribute maximum to total inequality among the house-

holds and trigger inequality in the state. On the contrary, livestock, and wages and salaries are the potential sources to bridge the inequality gap. Therefore, strategic interventions towards strengthening these subsectors and promoting the households towards diversifying their income sources would have better redistributive effect on farmers' income. However, it is important to keep in mind that in the western plain zone income from livestock triggers inequality in the region. Therefore, contribution of income sources to regional inequality should be kept in mind during policy formulation and implementation.

Non-farm business income has minimal share in total income; its distribution is highly skewed. Though any increment in income from non-farm business sources

would worsen the income distribution in the state; the effect is non-significant. Further, it is important to re-emphasize that non-farm sources have significant equalizing effect in the central plain zone, western zone and undulating plain zone of the state. Therefore, their contribution in inclusive development of rural Punjab cannot be completely overlooked.

Lastly, decomposition of Theil index reveals that within-group inequality is the principal contributor in total inequality across agro-climatic zones and districts. Policy intervention at individual district and zonal level would be imperative for correcting spatial imbalances in income distribution among farm households of Punjab, and would pave the way for their inclusive and more equitable development.

1. Bhalla, G. S., Chadha, G. K., Kashyap, S. P. and Sharma, R. K., Agricultural growth and structural changes in the Punjab economy: an input-output analysis. International Food Policy Research Institute, Washington, USA, Research Report 82, 1990.
2. Gulati, A., Roy, R. and Hussain, S., Getting Punjab agriculture back on high growth path: sources, drivers and policy lessons. Indian Council for Research on International Economic Relations, New Delhi, 2017.
3. Economic Survey, Department of Economic Affairs, Ministry of Finance, Government of India (GoI), 2017–18.
4. NSSO, Key indicators of situation of agricultural households in India. In 70th Round (January–December 2013), GoI, Ministry of Statistics and Programme Implementation, National Sample Survey Office, New Delhi, 2014.
5. Leibbrandt, M., Woolard, C. and Woolard, I., The contribution of income components to income inequality in the rural farmers' homelands of South Africa: a decomposable Gini analysis. *J. Afr. Stud.*, 2000, **9**(1), 79–99.
6. Kung, J. K. S. and Lee, Y., So what if there is income inequality? The distributive consequences of non-farm employment in rural China. *Econ. Develop. Cult. Change*, 2001, **50**(1), 19–46.
7. De Janvry, A. and Sadoulet, E., Income strategies among rural households in Mexico: the role of off-farm activities. *World Dev.*, 2001, **29**(3), 467–480.
8. BIRTHAL, P. S., Negi, D. S., Jha, A. K. and Singh, D., Income sources of farm households in India: determinants, distributional consequences and policy implications. *Agric. Econ. Res. Rev.*, 2014, **27**(1), 37–48.
9. Ranganathan, T., Farmers' income in India: evidence from secondary data. Agricultural Economics Research Unit, Institute of Economic Growth, New Delhi, 2015; [http://www.iegindia.org/ardl/Farmer\\_Incomes\\_Thiagu\\_Ranganathan.pdf](http://www.iegindia.org/ardl/Farmer_Incomes_Thiagu_Ranganathan.pdf) (accessed on 22 October 2018).
10. Richard, A. H. and He, J. J., Sources of income, inequality, and poverty in rural Pakistan. IFPRI Research Report #102, Washington DC, USA, 1995.
11. BIRTHAL, P. S., Joshi, P. K. and Kumar, A., Assessment of research priorities for livestock sector in India. Policy Paper 15, National Centre for Agricultural Economics and Policy Research, New Delhi, 2002.
12. Lanjouw, P. and Shariff, A., Rural non-farm employment in India: access, income and poverty impact. Working Paper 81. National Council of Applied Economic Research, New Delhi, 2002.
13. Lanjouw, P. and Stern, N., Agricultural change and inequality in Palampur. In *The Economics of Rural Organization: Theory, Practice and Policy* (eds Braverman, A., Hoff, K. and Stiglitz, J.), Oxford University Press, New York, USA, 1993.
14. Vatta, K. and Sidhu, R. S., Income diversification among rural households in Punjab: dynamics, impacts and policy implications. *Indian J. Labour Econ.*, 2007, **50**(4), 723–736.
15. Pavithra, S. A. and Vatta, K., Role of non-farm sector in sustaining rural livelihoods in Punjab. *Agric. Econ. Res. Rev.*, 2013, **26**(2), 257–265.
16. Sidhu, R. S., Vatta, K. and Singh, J., Pattern of employment and wage relation in Punjab agriculture. *Man Dev.*, 2012, **34**(3), 77–88.
17. Vatta, K. and Garg, B. R., Rural non-farm sector in Punjab: pattern and access to employment and income. *Indian J. Agric. Econ.*, 2008, **63**(2), 223–243.
18. Vatta, K., Garg, B. R. and Sidhu, M. S., Rural employment and income: the inter-household variations in Punjab. *Agric. Econ. Res. Rev.*, 2008, **21**(2), 201–210.
19. FICCI, Labour in Indian agriculture: a growing challenge, KPMG analysis, Federation of Indian Chambers of Commerce and Industry, 2015.
20. Chakravorty, S., Chandrasekhar, S. and Naraparaju, K., Income generation and inequality in India's agricultural sector: the consequences of land fragmentation. IGIDR Working Paper, WP-16-028, 2016.
21. Fields, G. S., *Poverty, Inequality, and Development*, Cambridge University Press, New York, USA, 1980.
22. Kaditi, E. A. and Nitsi, E. I., Vertical and horizontal decomposition of farm income inequality in Greece. *Agric. Econ. Rev.*, 2011, **12**(1), 69–80.
23. Lerman, R. and Yitzhaki, S., Income inequality effects by income source: a new approach and applications to the United States. *Rev. Econ. Stat.*, 1985, **67**(1), 151–156.
24. Kimhi, A., Arayama, Y. and Kim, J. M., Identifying determinants of income inequality in the presence of multiple income sources: the case of Korean farm households. In Poster presented at EAEE Congress 'Agri-Food and Rural Innovations for Healthier Societies', Slovenia, 2014.
25. Bellù, L. G. and Liberati, P., Describing income inequality: theil index and entropy classindexes. FAO EasyPo1051, 2006; [http://www.fao.org/docs/up/easypol/445/theil\\_index\\_051en.pdf](http://www.fao.org/docs/up/easypol/445/theil_index_051en.pdf) (accessed on 22 October 2018).
26. Punjab Revenue, 2012; <http://punjabrevenue.nic.in/for%20website/agro-climatic%20zone.htm> (accessed on 22 October 2018).

ACKNOWLEDGEMENT. We thank Dr Kamal Vatta, Director, Centers for International Projects Trust, New Delhi and the anonymous reviewers for their valuable suggestions that helped improve the manuscript.

Received 27 February 2019; revised accepted 8 August 2019

doi: 10.18520/cs/v117/i11/1855-1862