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Sources of family income and their effects on family income inequality: a study of fish farmers in Tripura, India

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Abstract An improved understanding of the sources of income and income distribution provides instructive insights into food insecurity and poverty, helping policy makers in the developing world to formulate new strategies for overcoming them. This paper analyses different sources of family income of fish farmers, and determines the impact that various income sources had on the overall level of family income inequality in the South Tripura district of Tripura in 2004–2005. Using decomposition of inequality by source, we examined how changes in particular income components affected overall inequality. Policies that increase fish yield in the study area have an important role to play in reducing poverty with negligible increase in income inequality. Increased income share from government jobs in lower income groups could play the dual role of alleviating poverty among relatively poor fish farmers and reducing income inequality among fish farming households in the study area.

Keywords Income inequality · Decomposition of Gini · Marginal effects of income source · Fish production · Tripura

Introduction

Income inequality is one of the major contributing factors to poverty and food insecurity in developing countries, and causes a substantial proportion of their populations to live in poverty and suffer from problems associated with chronic undernutrition (Peters and Shapouri 1997). Inequality also matters to the pace of poverty reduction that is achieved at any given rate of growth (Ravallion 2001). Achieving household food security in the less developed areas of the world requires both equity and growth.

In India, where about 27.5% of the population was living below the poverty line in 2004–2005 (Government of India 2007), the development problems have been and continue to be the eradication of mass poverty and reduction of inequality. Most food-insecure people live in the rural areas, and India has witnessed overall increases in rural income inequality between 1993–1994 and 1999–2000 (Deaton and Dreze 2002; Sundaram and Tendulkar 2003a, b; Sen and Himanshu 2005). A small reduction in income inequality in low income countries such as India, even in the absence of growth, can lead to substantial declines in poverty (Bruno et al. 1996) and food insecurity.

There is an ongoing and increasing interest in measuring and understanding the level, causes and development of income inequality (Heshmati 2004). An improved understanding of the sources of income and income distribution provides instructive insights into poverty and helps policy makers in the developing world to formulate new strategies for its reduction. The analysis of income distribution has remained an area of intense research since the publication of the seminal works of Kuznets (1955) and Chenery et al. (1974). Using various techniques, a number of empirical studies in individual developing countries have pinpointed the contribution of different sources of income to total income inequality (e.g., Pyatt et al. 1980; Nugent and Walther 1982; Ercelawn and Dolberg 1984; Mohammad and Badar 1985; Glewwe 1986; Kruijk 1987; Adams and Alderman 1992; Leibbrandt et al. 2000; Kung and Lee 2001; Singh 2006, 2007). However, for the policy perspective, it is important to investigate how changes in

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a particular income source will affect overall inequality, and what impact a marginal increase in a particular income source would have on inequality.

Aquaculture is considered to be an emerging growth sector in India. In recognition of the increasing role of freshwater aquaculture in fish production, the federal and state governments of India have been implementing various development programs (Katiha et al. 2005). Freshwater aquaculture is an important and promising sector of the economy of the state of Tripura. It has grown significantly over the years, from 14,172 metric tons in 2003–2004 (Singh 2006) to 30,840 metric tons in 2007–2008 (Government of Tripura 2009). The state had 17,375 hectares of water area with potential for aquaculture in 2007–2008, a rapid increase from 13,290 hectares in 2003–2004 and there were 93,870 fish farmers in 2003–2004 which increased to 125,247 in 2007–2008 (Government of Tripura 2009). Rice and freshwater fish form the staple diet of people in Tripura. The state government has been implementing a perspective plan in order to achieve self-sufficiency in fish production (Government of Tripura 2002). The state of Tripura is also one of five in India where both rural and urban income inequalities have increased between 1993–1994 and 1999–2000 (Government of India 2001). Hence, the present study has examined the extent of income inequality among fish farmers, including the effect of alternative sources of income on inequality as well as their relative and marginal effects in the South Tripura district of Tripura state during the year 2004–2005.

The results of the decomposition analysis have been used to identify different types of income sources for fish farmers which should prove useful for policy makers who concentrate on the twin problems of rural inequality and poverty.

Research methodology

Data and sampling design

Tripura is the smallest of the 7 northeastern states of India, predominantly hilly and surrounded on the north, west and south by Bangladesh and in the east by two other northeastern Indian states, Assam and Mizoram (Fig. 1). The human population of the state includes 19 tribal communities which amount to 30% of the total. Agriculture contributes about 64% of total employment and about 48% of the state's domestic product.

This study is based on primary cross sectional data collected from six villages from three development blocks in South Tripura, Matarbari block—Matarbari and Khilpara villages, Amarpur block—Kurmachhara and Uttar Chalagang villages, and Bagafa block—Santirbazar and Paschim

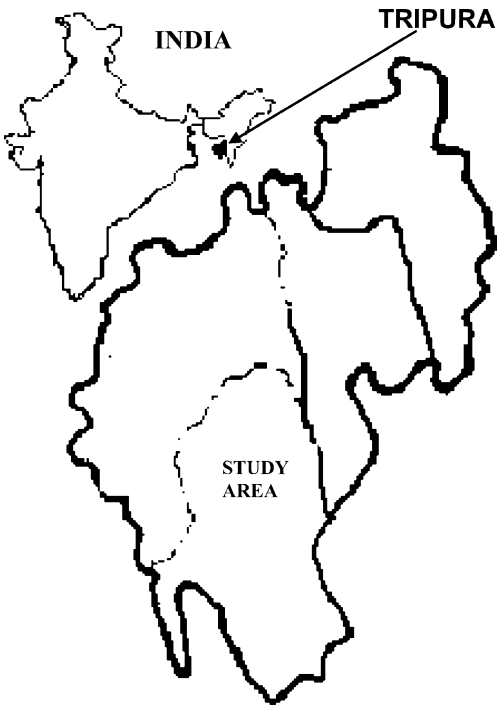

Fig. 1 Map of India showing the state of Tripura and map of Tripura showing the study area

Charakbai villages. They were selected as they account for about 30% of the total water area with potential for aquaculture and 31% of fish production of the state (Singh 2006). A sample of 250 fish farms proportionately allocated to villages was prepared with the help of the Fisheries Development Officers of the Department of Fisheries, Government of Tripura, but 11 were excluded on the basis of inadequate data. Data for detailed analysis were collected from a pre-tested interview schedule specifically designed for the study. Fish farms were visited during July and August 2005 and data were acquired for the previous agricultural year (July 2004 to June 2005) from the head and other members of the household.

Sources of income of fish producers were divided into those that were non-farm and those that were from the farm. Non-farm income sources included private jobs (salaried jobs in the private sector), government jobs (salaried jobs in the public sector), self-employment (trade, business or profession, either owned or as a partner), labor (wages from any unskilled non-farm activity), and other (pensions/transfer payments, etc.). Farm income sources were comprised of production of fish, fish fingerling/spawn, paddy, vegetables, poultry and milk, other farm income sources (piggery, farm labor) and fruit production.

Theoretical framework and analytical tools

The measures of income inequality can be divided into positive measures and normative measures. The positive

measures are derived from statistical concepts and make no explicit use of any concept of social welfare. These include the Gini coefficient, Lorenz curve, Theil measure, relative mean deviation, and the coefficient of variation. In contrast, the normative measures, the Dalton measure and the Atkinson index, links and integrates the measure of inequality with social welfare and rely on value judgments and a properly defined welfare function. Different authors (e.g., Champernowne 1972; Dasgupta et al. 1973; Kakwani 1980; Dagum 1980) have analyzed and discussed the properties and characteristics of several methods available to measure income inequality in the literature. The Gini, coefficient is considered to be the best measure of inequality and is widely used in economic research (Shorrocks 1982). Lerman and Yitzhaki (1984) and Shalit (1985) proposed algorithms, which simplify the calculation of the Gini coefficient and allow meaningful interpretations.

The ability to decompose measures of inequality from contributing sources is a desirable property for studies of economic inequality (Okamoto 2009). Several methods are available in the literature to decompose the Gini coefficient (Pyatt 1976; Bourguignon 1979; Shorrocks 1982; Lerman and Yitzhaki 1985; Silber 1989; Sastry and Kelkar 1994; Dagum 1997; Yao 1999; Morduch and Sicular 2002; Mussard et al. 2003; Paul 2004; Hiroshi 2005; Lopez-Feldman 2006; Okamoto 2009). Morduch and Sicular (2002) and Heshmati (2004) provide an expanded discussion of theoretical issues and examples of different approaches to decompose inequality by subgroups, income sources, causal factors and other unit characteristics.

Lerman and Yitzhaki (1985) developed an approach for decomposition of the Gini coefficient, which views the contribution of each source as a product of its own inequality, its share of total income and its correlation with rank cumulative total income. Their decomposition yields an intuitive interpretation of the elements making up each source's contribution to inequality (Stark et al. 1986). This approach appears more compelling and less arbitrary than other specifications of natural decomposition and an important advantage is its use in examining the marginal changes in size of an income source on overall inequality. The common approach used for examining marginal changes is to compare inequality with and without the income source in question (Reynolds and Smolensky 1977; Danziger 1980). This approach amounts to asking the less meaningful question of what a total elimination of one source would do to inequality, and can yield results that depend on the ordering of sources. The Lerman and Yitzhaki (1985) approach is free from these disadvantages and has been used recently in several empirical studies in developing countries (e.g., Paul 2004; Singh 2006, 2007; Azam and Sharif 2009).

Given its advantages and usefulness, we have employed the Lerman and Yitzhaki (1985) approach in the present study. The decomposition of overall/conventional *Gini* (G) by income source obtained by them is as follows:

$$G = \frac{2\mathrm{cov}[y, F(y)]}{m} = \frac{2\sum_{k=1}^{K} \mathrm{cov}[y_k, F(y)]}{m}$$

$$= \sum_{k=1}^{k} \left[\frac{\mathrm{cov}[(y_k, F(y)]}{\mathrm{cov}[(y_k, F(y_k)]} \times \frac{2\mathrm{cov}[(y_k, F(y_k)]}{m_k} \times \frac{m_k}{m} \right]$$

Defining

$$R_k = \frac{\mathrm{cov}[(y_k, F(y)]}{\mathrm{cov}[(y_k, F(y_k)]}; G_k = \frac{2\mathrm{cov}[(y_k, F(y_k)]}{m_k}; S_k = \frac{m_k}{m},$$

G can be written as

$$G = \sum_{k=1}^{k} [R_k \times G_k \times S_k]$$

Where 'y' represents the income, 'k' represent the income component and G_k is the relative *Gini* component of the k^{th} income source; R_k is the *Gini* correlation of the k^{th} income component with the rank of cumulative family income, which has properties similar to Pearson's and the rank correlations; S_k is the component of the k^{th} source's share in total income; y_k is the k^{th} component of family income; F and F_k are the ranks of cumulative distribution of family income and of the k^{th} income source, respectively, obtained after arranging in ascending order; and m and m_k are the total family income and share of the k^{th} income source in the family income, respectively.

The income source's inequality contribution (I), relative income inequality (RII), and relative marginal effect (RME) for the k^{th} source of family income are obtained as follows:

$$I_k = R_k \times G_k \times S_k \div G$$

$$RII_k = I_k \div S_k$$

$$RME_k = I_k - S_k$$

Where R_k, G_k, and S_k have the meaning defined earlier.

Results and discussion

We have depicted the source of income distribution of fish farming households along with family income (averaged over the households deriving income from a particular source) in Table 1. The estimated average family income from all sources was Indian Rupees (INR) 76,813 per year. The results are comparable with the income of fish farmers in the West Tripura district of Tripura (INR 88,127 per

Table 1 Sources of income of fish farming households of the South Tripura district of Tripura, 2004–2005

Source of income	Percent of all households	Average Income[a] (INR/year)
Private job	6.69	69338
Government job	30.54	85191
Self employment	52.72	33764
Non-farm labor	20.50	13959
Other non-farm sources	11.30	34496
Total non-farm Sources	***96.23***	***57383***
Fish production	100.00	10605
Fish fingerling/spawn production	3.35	156838
Paddy production	28.03	16725
Other farm sources	17.58	5962
Total farm sources	***100.00***	***21591***
Total all sources	***239.00***	***76813***

[a] Averaged over the households deriving income from a particular source

year) in 2003–2004 but the average family income from fish production there was INR 28,874 per annum higher than that obtained in the present study (Singh 2006, 2007). This was mainly due to the average pond area, which was 0.20 hectare in the sample farms in the West Tripura District (Singh 2006, 2007) as compared to 0.14 hectare per sample farm in the South Tripura district of Tripura.

Among the sources of family income considered, fish production, government job, self-employment, and paddy production in descending order were important sources of family income. More than 96% of fish farming households were deriving income from non-farm sources of income. The comparison of non-farm and farm income sources shows that the average income from non-farm sources (weighted averaged over the percentage of households deriving income) was substantially higher (166%) than that of farm sources of income. Government job followed by private job were the most remunerative of non-farm sources of income. Among the farm sources of family income, fish spawning and fingerling production followed by paddy production and then fish production were the highest paying sources of family income. Average income from government jobs and fish spawning and fingerling production was 703% and 1,379% higher than that of income from fish production.

In order to delve more deeply into levels of family income and their sources and the extent of poverty and income inequality, we have divided fish farming households into quarters (Table 2). Quarter I represents the lowest income group and quarter IV the highest. Given an average family size of 4.78 (Singh and Pandey 2006) and a national average per capita income of INR 12, 416 in 2004–2005, more than 58% of the households sampled had a per capita income lower than this. Considering the INR-US$ exchange rate of 43.56 and the international extreme poverty line[1] of US$ 1.25 per day (INR 19, 874) during the study period, 77% of the sampled families were suffering from extreme poverty. About 50% of the sampled households had an income of less than US$ 0.625 (half that of the extreme poverty line) and that of the lowest income group was US$ 0.22 a day.

If we compare the poverty figures according to the criterion used by the Planning Commission of India of INR 356.30 per capita per month for rural communities (= US$ 0.27 per capita per day) about 20% of the sampled population as against 22% in rural India was living below the poverty line in 2004–2005 (Government of India 2007). A Government of India report (2007) did not state a specific poverty line for Tripura but did give INR 387.64 per month (US$ 0.30 per capita per day) for Assam (another north-eastern state of India). Using this as a proxy for rural Tripura, 23% of fish farming households were below the line.

The extent of income inequality in the study area among fish farming households can be seen in Table 2. The average family income in the highest income group was about 11 times of the income of the lowest income group. The average family income in quarter III was more than double that of quarter II. Fish fingerlings/spawn production, which is the highest paying source of family income, provided income to 3.35% households (Table 1) and overall contributed more than 7% to family income (Table 2). However, it seems to be the major source of income inequality as its contribution was as high as 12% in the highest income group and nil in the two lower income groups. This inequality can be attributed to some extent to pond size which is one of the most important determinants of production (Singh 2007). Production of fish fingerlings/spawn is a highly specialized and capital-intensive process which can only be carried out by rich and well trained farmers with large holdings.

Government jobs, which provided income to 31% of the selected fish farming households was the second highest paying source after fish fingerlings/spawn production (Table 1). It clearly played an important role in making

[1] Extreme poverty is defined as the proportion of individuals in developing countries who live on less than $1.25 a day (based on purchasing power parity 2005 constant prices).

Table 2 Share of different sources of family income (percent), South Tripura district, Tripura, 2004–2005

Source of income	Income Quarter				
	I	II	III	IV	Overall
Private job	1.57	3.44	3.81	8.83	6.49
Government job	4.85	11.61	32.09	46.71	36.37
Self employment	44.90	46.40	39.10	11.90	24.88
Non-farm labor	27.09	14.30	2.79	0.08	4.00
Other non-farm sources	6.26	3.90	5.94	5.49	5.45
Total non-farm Sources	***84.67***	***79.65***	***83.73***	***73.01***	***77.19***
Fish production	3.94	10.66	5.32	8.03	7.45
Fish fingerling/spawn production	0.00	0.00	2.31	11.90	7.34
Paddy production	9.82	8.49	6.70	5.75	6.55
Other farm sources	1.57	1.20	1.94	1.30	1.46
Total farm sources	***15.33***	***20.35***	***16.27***	***26.99***	***22.81***
Total all sources	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***
Average family income (INR/year)	*16522*	*38147*	*77601*	*176647*	*76813*
No. of fish farming households	*60*	*60*	*60*	*59*	*239*
Average pond area (hectare per farm)	0.10	0.13	0.14	0.19	0.14

'I' is the lowest income quarter and 'IV' is the highest income quarter

income distribution inequitable as it provided employment to many more in the higher income groups than those in the lower income groups (Table 2). Private jobs were another important source of income inequality among fish farmers. Income from self-employment, non-farm labor and paddy production were higher in lower income groups and, although less remunerative than other sources, played an important role in the income of poor households, making income distribution more equitable (Tables 1 and 2).

Estimates of the decomposition analysis are presented in Table 3. The income inequality observed in South Tripura District (as given by overall *Gini*=0.50) is comparable with the income inequality observed in West Tripura District of Tripura (0.43–0.45) (Singh 2007), rural India (0.46 to 0.50) (Azam and Sharif 2009) and many developing countries such as Brazil (0.57), South Africa (0.62), Bolivia (0.42), Malaysia and the Philippines (0.50) (Deininger and Squire 1996). A positive *Gini* correlation (R_k) between the income from different sources and the rank of the cumulative family income was observed except for income from non-farm labor. This is consistent with the findings of Singh (2007) in the West Tripura district of Tripura state.

The contribution of non-farm sources to family income inequality was 70% (Table 3). Davis et al. (2010) examined the effect of rural non-farm activities on income inequality in a number of developing and transition countries, and suggested that non-farm income induces greater income inequality. Government job was the most important source of income inequality (49% contribution) as given by I_k (Table 3). Fish fingerlings/spawn production was the second most important contributor (14% contribution) to income inequality. Private jobs, self-employment and fish production

Table 3 Impacts of alternative income sources on family income inequality, South Tripura district, Tripura, 2004–2005

Income source	R_k	G_k	S_k	I_k	RII_K	RME_k
Private job	0.4121	1.8331	0.0649	0.0978	1.5078	0.0329
Government job	0.5294	1.2652	0.3637	0.4862	1.3368	0.1225
Self employment	0.2207	0.8700	0.2488	0.0954	0.3833	−0.1535
Non-farm labor	−0.2710	1.4725	0.0400	−0.0319	−0.7965	−0.0719
Other non farm sources	0.2835	1.7129	0.0545	0.0528	0.9694	−0.0017
Fish production	0.4236	1.3885	0.0745	0.0874	1.1739	0.0129
Fish fingerling/spawn production	0.5008	1.9184	0.0734	0.1407	1.9174	0.0673
Paddy production	0.3198	1.3791	0.0655	0.0577	0.8803	−0.0078
Other farm sources	0.2768	1.7008	0.0146	0.0138	0.9395	−0.0009
Total	–	**0.5010**	1.0000	1.0000	–	–

R_k = 'Gini correlation' of the k^{th} income component with the rank of cumulative family income; G_k = Relative Gini component of the k^{th} income source; S_k = Income share of the k^{th} source, I_k = The k^{th} income source's inequality contribution; RII_k = The k^{th} income source's relative income inequality; RME_k = Relative marginal effect for the k^{th} source of family income. Figures in bold denote conventional Gini (G)

were other important positive contributors to income disparities among fish farmers. Non-farm labor was the only source of income contributing to income equality (Table 3).

Relative measures offer more appropriate comparisons. The relative income inequality (RII_k) of fish fingerlings/spawn production was the highest (1.92), which implies that, with a 100% increase in the share of income from fish production in family income, its share in family income inequality would increase by 192%. The relative effects of an increase in income shares on income inequality were more than 1, other than fish fingerlings/spawn production, for private jobs followed by government job and then fish production in descending order. The relative effects were less than 1 for self-employment and paddy production, and negative for non-farm labor. These results are consistent with indications of the role of different sources of income inequality in Tables 1 and 2, as discussed in previous sections.

The negative sign of RME_k (Table 3) indicates an indirect relationship between income inequality and income share by source. With a 1% increase in the income share of self-employment, inequality will decrease by an average of 15%. Increasing income shares of self-employment, non-farm labor and paddy production can reduce income inequality among fish farmers but self-employment is the most important.

Conclusions

The present paper shows that increasing the income share of self-employment, non-farm labor and paddy production could alleviate poverty and reduce income inequality among fish farming households in the South Tripura district of Tripura. Although increasing the income share of fish production would not decrease inequality, it is one of the most important sources of income and has the potential for increase. The average fish yield in the study area was very low, 1,461 kg per hectare, compared with scientific composite fish culture, 2,500 kg per hectare (Government of Tripura 2002). Therefore, policies to increase fish yield in the study area have an important role to play in reducing poverty, although they are unlikely to alter income inequality significantly. Government jobs have high potential to reduce poverty among a significant proportion of the population (31% of fish farming households). Increasing the share of government jobs of lower income groups could play the dual roles of alleviating poverty among relatively poor fish farmers and reducing income inequality among fish farming households in the study area.

These findings suggest that policy makers who are interested in improving food security and reducing poverty in Tripura must pay more attention to creating self-employment opportunities in the South Tripura District of Tripura. Strategies to increase income from fish production by increasing yield are of paramount importance in raising income levels of the large majority of fish farmers but would have negligible impact on income inequality. Policy makers should consider a multi-sectoral approach for promoting equitable growth because sectoral policies on fish alone would be insufficient.

References

Adams RH Jr, Alderman H (1992) Sources of income inequality in rural Pakistan: a decomposition analysis. Oxf Bull Econ Stat 54 (4):591–608

Azam M, Sharif A (2009) Changes in income inequality in rural India: decomposing the Gini by income sources. http://people.smu.edu/mazam/Azam-04.pdf. Accessed 22 October 2009

Bourguignon F (1979) Decomposable inequality measures. Econometrica 47(4):901–920

Bruno M, Ravillion M, Squire L (1996) Equity and growth in developing countries, old and new perspectives on the policy issues. Policy Research Working Paper No. 1563. The World Bank, Washington, DC

Champernowne DG (1972) A comparison of measures of inequality on income distribution. Econ J 84(336):787–816

Chenery H, Ahuwalia MS, Bell C, Duloy JH, Jolly R (1974) Redistribution with growth. Oxford University Press, New York

Dagum C (1980) Inequality measures between income distributions with applications. Econometrica 48:1791–1803

Dagum C (1997) A new approach to the decomposition of the Gini income inequality ratio. Empirical Econ 22(4):515–531

Danziger S (1980) Do working wives increase family income inequality? J Hum Resour 15:444–451

Dasgupta P, Sen A, Starrett D (1973) Notes on the measurement of inequality. J Econ Theory 6(2):180–187

Davis B, Winters P, Carletto G, Covarrubias K, Quinones EJ, Zezza A, Stamoulis K, Azzarri C, Digiuseppe S (2010) A cross-country comparison of rural income generating activities. World Dev 38 (1):48–63

Deaton A, Dreze J (2002) Poverty and inequality in India: a re-examination. Econ Polit Wkly 7:3729–3748

Deininger K, Squire L (1996) A new data set for measuring income inequality. World Bank Econ Rev 10(3):565–591

Ercelawn A, Dolberg F (1984) Income inequality in rural Pakistan: a study of sample villages. Pak J Appl Econ 3:1–28

Glewwe P (1986) The distribution of income in Sri Lanka in 1969–70 and 1980–81: a decomposition analysis. J Dev Econ 24(2):255–274

Government of India (2001) National human development report of India, 2001. Planning Commission, Government of India, New Delhi

Government of India (2007) Poverty estimates for 2004–05. Press Information Bureau, Government of India. http://www.planningcommission.gov.in/news/prmar07.pdf. Accessed 1 July 2010

Government of Tripura (2002) Perspective plan for attaining self-sufficiency in fish production in Tripura 2002–2010 A.D. Department of Fisheries, Government of Tripura

Government of Tripura (2009) Fisheries at a glance in Tripura 2007–08. http://tripura.nic.in/fisheries/FisheryataGlance.htm. Accessed 23 August 2009

Heshmati A (2004) A review of decomposition of income inequality. IZA Discussion Paper No. 1221. http://ftp.iza.org/dp1221.pdf. Accessed 1 July 2010

Hiroshi H (2005) Parametric decomposition of the Gini coefficient: how change of subgroup affects an overall inequality. Sociol Theory Methods 20(2):241–256

Kakwani NC (1980) Income inequality and poverty. Oxford University Press, New York
Katiha PK, Chakraborty C, Jena JK, Pillai NGK, Dey MM (2005) Inland aquaculture in India: past trend, present status and future prospects. Aquac Econ Manag 9(1–2):237–264
Kruijk HD (1987) Sources of income inequality in Pakistan. Pak Dev Rev 26(4):659–670
Kung JKS, Lee Y (2001) So what if there is income inequality? The distributive consequence of nonfarm employment in rural China. Econ Dev Cult Change 50(1):19–46
Kuznets S (1955) Economic growth and income inequality. Am Econ Rev 45(1):1–28
Leibbrandt M, Woolard C, Woolard I (2000) The contribution of income components to income inequality in the rural former homelands of South Africa: a decomposable *gini* analysis. J Afr Stud 9(1):79–99
Lerman RI, Yitzhaki S (1984) A note on the calculation and interpretation of the Gini index. Econ Lett 15(3–4):363–368
Lerman RI, Yitzhaki S (1985) Income inequality effects by income source: a new approach and applications to the United States. Rev Econ Stat 67(1):151–159
Lopez-Feldman A (2006) Decomposing inequality and obtaining marginal effects. Stata J 6(1):106–111
Mohammad F, Badar G (1985) Structure of rural income in Pakistan: some preliminary estimates. Pak Dev Rev 24(3&4):385–403
Morduch J, Sicular T (2002) Rethinking inequality decomposition, with evidence from rural China. Econ J 112(476):93–106
Mussard S, Seyte F, Terraza M (2003) Decomposition of Gini and the generalized entropy inequality measures. Econ Bull 4(7):1–6
Nugent J, Walther R (1982) Short-run changes in rural income inequality: a decomposition analysis. J Dev Stud 18(2):239–269
Okamoto M (2009) Decomposition of Gini and multivariate Gini indices. J Econ Inequal 7(2):53–177
Paul S (2004) Income sources effects on inequality. J Dev Econ 73 (1):435–451
Peters MM, Shapouri S (1997) Income inequality and food security. Economic Research Service/USDA. http://www.ers.usda.gov/Briefing/GlobalFoodSecurity/PDF/gfa9cIncomeInequalityandFoodSecurity.pdf. Accessed 29 April 2010
Pyatt G (1976) On the interpretation and disaggregation of Gini coefficient. Econ J 86(342):243–255
Pyatt G, Chen C, Fei J (1980) The distribution of income by factor components. Q J Econ 95(4):451–473
Ravallion M (2001) Growth, inequality, and poverty: looking beyond averages. World Dev 29(11):1803–1815
Reynolds M, Smolensky E (1977) Public expenditure, taxes and the distribution of income. Academic, New York
Sastry DVS, Kelkar UR (1994) Note on the decomposition of Gini inequality. Rev Econ Stat 76(3):584–586
Sen A, Himanshu (2005) Poverty and inequality in India: getting closer to the truth. http://www.networkideas.org/featart/may2004/Poverty_WC.pdf. Accessed 1 July 2010
Shalit H (1985) Calculating the Gini index for individual data. Oxf Bull Econ Stat 47(2):185–189
Shorrocks AF (1982) Inequality decomposition by factor components. Econometrica 50(1):193–211
Silber J (1989) Factor components, population subgroups and the computation of the Gini index of inequality. Rev Econ Stat 71 (1):107–115
Singh K (2006) Relative and marginal effects of fish production on family income inequality in Tripura: decomposition of *Gini* by income sources. Agric Econ Res Rev 19(2):353–366
Singh K (2007) Economics and determinants of fish production and its effects on family income inequality in West Tripura district of Tripura. Indian J Agric Econ 62(1):113–125
Singh K, Pandey DK (2006) Microeconomic analysis of fish production and marketing systems in South Tripura district of Tripura. Final Project Report, Dept. Of Fisheries Economics & Statistics, College of Fisheries, Central Agricultural University, Tripura, India
Stark O, Taylor JE, Yitzhaki S (1986) Remittances and inequality. Econ J 96(383):722–740
Sundaram K, Tendulkar SD (2003a) Poverty has declined in the 1990s: a resolution of comparability problems in NSS consumer expenditure data. Econ Polit Wkly, 25–31 January: 327–337
Sundaram K, Tendulkar SD (2003b) Poverty in India in the 1990s: an analysis of changes in 15 major states. Econ Polit Wkly, 5–11 April: 1385–1393
Yao S (1999) On the decomposition of Gini coefficients by population class and income source: a spreadsheet approach and application. Appl Econ 31(10):1249–1264

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