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Bamboo sector reforms and the local economy of Linan County, Zhejiang Province, People's Republic of China

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Abstract

The impact of county-level bamboo sector reforms on bamboo contributions to the county economy is examined by using aggregate county data and simple analytical methods. The role of the contributions of bamboo to the different income groups is evaluated on the basis of data, for 1987 and 1997, from 46 households and by using Gini coefficients, relative and absolute inequality weights, and movements of households through different income groups. Fresh bamboo shoot (FBS) production increased from US$0.1 million in 1983 to US$29 million in 1996. Allocation of labor and capital reached near optimal by the end of the first phase of forestland reforms in 1987. Industrial reforms could affect land allocation through price incentives. Market reforms had a much higher impact through price incentives on land allocation. Bamboo contributions have benefited poor as well as rich groups, and these contributions have moved many households from the poorer to the richer classes. Bamboo sector reforms have reduced the inequality in bamboo land and bamboo income but the share of bamboo income in the total income inequality has increased. The local governments should recognize these outcomes and the basic differences in the production of different bamboo products to design future reforms.

Keywords: Income inequalities; Industrial reforms; Land reforms; Market reforms

1. Introduction

China, since 1978, has undergone drastic but gradual changes in policies related to land allocation, industrial production, foreign capital investment, and markets. In this process, the Chinese government has placed a special emphasis on the forest sector. Many authors, such as Menzies and Peluso (1991), Sun (1992), Yin (1994), Song et al. (1997), Yin (1998) have studied the broader aspects of the forest sector reforms. Ruiz-Perez et al. (1996, 1999) have studied the impacts of the bamboo sector[1] (a part of the forest sector) re-

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forms on the economy of Anji county in Zhejiang province, and have provided many insights of these reforms and their impacts at the county-level economy. However, many other issues still need to be addressed.

First, Ruiz-Perez et al. (1996) do not provide specific features of bamboo (or forest) land reforms. Second, they discussed only the impact of country-level reforms on a county economy. Third, they examined the impact of land reforms on bamboo timber production, industrial reforms on bamboo processing, and trade reforms on the export of bamboo products. We believe that the production of bamboo is influenced by all-land, industrial and market-reforms. Fourth, Ruiz-Perez et al. (1999) found that bamboo had the higher relative importance for middle-class farmers as opposed to poor farmers. However, due to limitations in the data, they were unable to analyse the dynamics of the income contributed by different sectors, and the movement of households through income groups. Hence, it is not clear whether the comparison of the contribution of bamboo to different income groups at different times will really indicate the role of bamboo income to poor households. Fifth, the findings of Ruiz-Perez et al. (1996, 1999) are based on data from Anji County, where the major share of bamboo returns comes from bamboo timber. In some other counties, the major share comes from fresh or dried bamboo shoots. Hence, the findings of Ruiz-Perez and colleagues may not withstand the test of universality.

In this paper, we address these issues. The paper is focused on the impact of county-level bamboo sector reforms on the contribution of the bamboo sector to the county economy; and the role of the contributions of the bamboo sector to different income groups. The first four issues mentioned in the previous paragraph are addressed in the analysis of these two aspects. In addition, the paper is based on Linan County where the major share of bamboo contributions comes from fresh bamboo shoots (FBS). Hence, the results of this paper will broaden the scope of the research on the bamboo sector. The impact analysis of county-level reforms on local economy is based on aggregate data of Linan County. The study of the role of bamboo sector contributions to the different income groups is based on two data sets, for 1987 and 1997, from 46 households of five village groups. Hence, the scope of the income distribution component of the study may be limited.

Next, the methodology of data collection and analysis is described. Second, background information on Linan County is given. Third, the main features of bamboo land reforms in Linan County are discussed, and a brief overview of bamboo-related industrial and market reforms and extension activities is presented. Fourth, impact analysis of bamboo sector reforms on local economy is presented. Fifth, the contributions of the bamboo sector to five income groups (quintiles) and its impact on income inequalities are analyzed, and the results are compared with the study of Anji county by Ruiz-Preez et al. (1999). Finally, suggestions for future policy are discussed.

2. Methodology

Information on bamboo sector reforms was collected through participatory discussions with representatives from the local forestry bureau, forest college, local government, bamboo associations, local bamboo-based industries, and farmers. Annual reports and policy papers of the forestry bureau were examined. General economic and forestry data, and data related to the production and prices of FBS, DBS, rice, silk, and tea, were collected from documentation from the forestry and statistical bureaus. A separate questionnaire was used to collect quantity and price data of inputs and outputs for each crop, and data were collected from a minimum of five farmers and a crop specialist, from the forest college, for each crop.

In order to examine the role of bamboo sector contributions to different income groups, five vil-

[1] In China, bamboo occupies 7 million ha (3.9 million ha plantation and 3.2 million ha natural forests) which is more than one-quarter of the world's total bamboo area (Zhong et al., 1997).

lage groups, consisting of 46 households (population: 175 in 1997) under the same village government, of Gaohong Township were chosen. Household data on demographic variables, such as the number of workers, education level, gender distribution, and social and economic variables, such as land holdings and the income contributions of primary, secondary, and tertiary sectors, were collected through a questionnaire [available in Kant and Chiu (1999)] survey. In 1987, a detailed social survey was conducted by Professor Zhou Guomo, Linan Forestry College, Linan in the same village. The 1987 survey included all the variables included in our survey and covered all the 46 households. Hence, 1987 data for these 46 households were collected from the data bank of Professor Guomo (1988).

To analyze the impact of bamboo sector reforms, the trend of total contribution of the bamboo sector to the county GDP is examined over a period from 1983 to 1996. To segregate the impact of three reforms — land, industrial, and market — the total period is divided in three periods — 1983 to 1987, 1988 to 1990, and 1991 to 1996 on the basis of the starting years of different reforms. The comparative economic advantage of FBS over other land-based products such as rice, tea, and silk cocoons is evaluated in the terms of Benefit Cost (B–C) ratios and economic returns per unit of land area. The effects of different reforms on bamboo production are decomposed by simple analytical analyses based on the area, production, productivity, and prices of products during the three periods.[2]

A multi-pronged approach is used to evaluate the contribution of the bamboo sector returns to different income groups. The contribution of the bamboo sector to household income is analyzed for 2 years — 1987 and 1997. First, village-level aggregate changes in agricultural land, land under FBS, total income, per capita income, and bamboo contributions are examined. Second, inequalities in the distribution of different resources such as land and labor, and inequalities in income from primary, secondary, and tertiary sectors, and components of primary sector — agriculture, bamboo, and animal husbandry — are examined by using the Gini coefficient.[3] Third, income inequality is decomposed by income sectors using the relative and absolute inequality weights[4] proposed by Shorrocks (1982) and used by Tsui (1996). Fourth, households are ranked in decreasing order of household income, and grouped in five income groups (quintiles), each contributing approximately one-fifth of the total income. The changes in the contributions of bamboo and other sectors to the income of different quintiles over a 10-year period are examined. Fifth, the movement of households from one quintile to another quintile and the role of bamboo income in this movement are analyzed. Sixth, the contribution of bamboo income to a group of 10 households, who remained stationary in the poorest quintile over a

[2] The results of segregation should be interpreted only as indicators and not in absolute terms. As explained in Section 5.2 and 5.3, various factors and their causal mechanisms work simultaneously, and absolute separation is not possible in any situation, and specifically in this case, due to limited data. In the present case, at least four mechanisms — long-term trends due to the pre-reform period, medium to long-term effects of economic reforms, medium-term effects of incentives and income elasticities, and short-term effects of price ratios of different crops — will work together. In addition, a time-series data on workforce in the bamboo sector was not available which could have provided some other insights about the impact of bamboo sector reforms on local economy. (We are thankful to one of the reviewers for bringing out these points.)

[3] Gini coefficient (G) measures income inequality, and it varies from 0 to 1. The value of G closer to 0 means less inequality.

[4] Assume that there are M sectors, and K households. Let, Y_i is the total income of household I, and Y_i^m is the income of household i from the mth sector. Hence, $Y_i = \Sigma_I^M Y_i^m$. The decomposition determines the contribution of each sector to overall inequality $I(Y)$ where $Y = (Y_1, Y_2, \ldots..Y_K)$, that is: $I(Y) = S_1 + S_2 + S_M$, where S is the absolute factor inequality weight measuring the absolute contribution of the ith sector to overall inequality. The relative factor inequality weight measuring the proportion of the contribution of the sector, m, to overall inter-household inequality is defined as $s_m = (S_m/I)$. By requiring S_m to satisfy certain desirable axioms, Shorrocks (1982) has shown that s_m can be estimated by $s_m = \text{cov}(Y^m, Y)/\text{var}(Y)$. Hence, the relative factor inequality weight is the same irrespective of the inequality index used. But the trend of S_m is not necessarily the same as that of s_m because S_m depends on both the movements of s_m and $I(Y)$.

10-year period, is examined. Based on the outcomes, conclusions are drawn about bamboo contributions to different income groups. The results are compared with the Anji county study by Ruiz-Perez et al. (1999).

3. Linan County and bamboo

Linan is one of 10 counties known as 'bamboo counties' and is located in Zhejiang Province. The county has a population of 504 254 people, 87% of which are farmers, with 39 townships and 665 villages. In 1996, the GDP per capita in Linan was US$1398 while that of China was US$497. Linan has a total area of 313 478 ha, of which 259 500 ha is forestland. The main bamboo product of the county is fresh bamboo shoots (FBS) (shoots of *Phyllostachys praecox*, common local name Lei bamboo). The two other products are dry bamboo shoots (DBS) (shoots of *Phyllostachys dulcis, P. vivax, P. glabrata* and *P. pubescens*) and bamboo timber from Moso bamboo *(P. pubescens).* Bamboo shoots cover approximately 47 000 ha, 15% of forest area, and 119 901 ha is timber forest (Zhu, 1997, p.176).

4. Bamboo sector reforms in Linan County

In the county, land reforms have been the same for all forestland including bamboo land, but industrial and market reforms of the bamboo sector have distinct features than that of other forest products. Hence, land reforms are discussed, in general, as forestland reforms, and industrial and market reforms are discussed specific to the bamboo sector.

4.1. Land reforms

In China, local level governments are semi-autonomous, and have substantial autonomy in developing local level policies. Hence, each county has developed its forest land reforms within the broad national framework provided by the 1981 National Forest Policy. Linan county initiated its forestland reforms in 1982, and the county government continues to revise the existing forestland tenure system to better meet the challenges of efficiency and equity (Wong Anguo, 1998, personal communication). The forestland reforms resulted in the distribution of forestland under three categories: individual use land, Farmers Household Responsibility System (HRS) land, and contract land. Individual use land is mainly to meet basic subsistence needs of the household; distribution of land is based on the total population of the household, and land is inheritable. The land allocated to a household under HRS is proportional to the number of workers in the household. Contract land is distributed on the basis of management capacity of a household. HRS and contract lands are allocated for 15 years. These systems of land allocation are designed to balance equity and efficiency (Wong Anguo, 1998, personal communication). The primary focus of individual use land is on equity, HRS on equity cum efficiency, and contract land on efficiency. However, some equity mechanisms are built into the contract system. Contract land is distributed using methods of auction, rent, and the shareholding. The main objective of the auction system is efficiency. But three mechanisms are built into the auction system to ensure that large-scale disruptions of equity do not occur. First, land area allocated to an individual household must be less than double the area available per household. Second, only 10% of land is made available for auction. Third, lower quality land is auctioned first. The rental system, in which rent is not due until the fifth year, is designed to encourage participation of specialized but poor households. The shareholding system is designed to pool scarce resources from different partners, such as individual households, state-run enterprises, forestry bureaus, township governments, and forestry colleges. In addition to these three forms of land tenures, some state-owned farms and collective farms also exist

However, these careful designs of forestland reforms posed many problems. First, uncertainty, due to farmers' lack of confidence in reforms and the short-duration of 15 years for land use rights, encouraged the large-scale harvesting of timber and discouraged long-term investments in these

lands. Second, due to the heavy emphasis on equity, each site, such as the top, middle, and bottom of the hill, was divided equally among all households resulting in every household having many small land plots and different households having management rights for different crops in the same plot. Third, informal nature of the contract between local government and farmers made implementation difficult. Finally, absence of rent for the land distributed under HRS constrained the financial resources of local governments.

In view of these problems, Hongqiao Township began an experiment on forest tenures that was later emulated by the county government. Many changes, based on this experiment, have been made to forestland tenure system effective September 1998. Some of these changes are the extension of the period of tenure to 50 years; the inheritance or transfer of land during the period of contract; a chance to re-contract the land on the expiry of contract; entitlement of 50% of the profits to the old owner for the following 3 years if the land is contracted to a new owner; a security deposit to ensure forestry development on newly acquired land; and, the entry of outsiders to contract land. However, the impact of these changes on bamboo production and local economy is beyond the scope of this paper.

4.2. Industrial and market reforms

Bamboo-processing units, prior to 1987, were owned and managed by county or township governments. In 1987, the bamboo-processing sector was opened to private entrepreneurs, and decentralized decision-making, at the level of township governments, resulted in different forms of bamboo-based enterprises such as private enterprises having management rights only, leasing the land and equipment for the fixed period, and having shareholding arrangements with the government. As an outcome of this process, out of a total of 11 bamboo shoot processing units in the county, five are private, four are collective, and two have shareholding arrangements. Opening up of the sector also resulted in the establishment of small-scale units by individuals, diversification and introduction of new products, and sub-contracting by industrial units.

The prices of bamboo products were entirely controlled by the state and products were purchased by State Marketing Cooperatives up until 1987, but there was no quota for bamboo products. In 1987, the bamboo-sector market was opened for private enterprises and that increased pressure on bamboo product prices, but prices were still determined by the state. In 1990, state price control was removed, and prices became determined by the market. The state even stopped purchasing bamboo products. As a consequence, many township governments took initiatives to facilitate the marketing of bamboo products by local farmers that resulted in the establishment of 10 bamboo markets in Linan County, and the emergence of many local traders.

4.3. Extension activities and other factors

The Association of Bamboo, established in 1985, and the county forestry bureau organize extension activities. In the period of 1985–1988, a cash incentive of US$545/ha [300 yuan/mu; 15 mu = 1 ha, and US$1 = 8.25 Chinese Yuan)] was given to farmers for new bamboo plantation by the county government. The high demand of fresh bamboo shoots during the Spring Festival forced the local researchers to work on a technology to get early shooting of bamboo shoots which is closely related to soil temperature, and begins with a temperature of 9–10°C, normally in early March. Local researchers found that covering the land under Lei bamboo with bamboo leaves, rice or wheat straw, dried grasses, etc., promotes early shooting by raising soil temperatures and increases the productivity of the land. The details of this covering technology — the best material to cover, thickness of covering layer, duration of covering, and time to begin covering — were finalized and commercialized in 1990.

Hence, the total period of 1983–1996 has three distinguished phases: first, 1983–1987 — the period of land reforms and cash incentives, second,

1988–1990 — the period of industrial reforms, and third, 1991–1996 the period of market reforms and introduction of covering technology. Extension activities have been ongoing throughout 1983–1996.

5. Bamboo sector reforms, bamboo production, and the local economy

The bamboo sector reforms coupled with other reforms have had a great impact on the local economy. In the county, the GDP per capita rose from US$209 in 1985 to US$267 in 1991 and US$1398 in 1996. The average contribution of bamboo to farmers' income rose from approximately one-tenth of total household income in the early 1980s, to approximately one-third in 1996. The major portion of the bamboo contribution comes from FBS. In the 10 townships in the county, FBS contributed more than US$1.2 million/year from 1995 to 1997. The value of FBS production in the county increased from US$100 000 in 1983 to over US$2.55 million in 1987. FBS production increased to US$4 million in 1989 but dropped to US$3 million in 1990. However, in 1993, FBS production jumped to US$8.6 million. This significant increase continued in 1994, 1995 and 1996, with values of over US$12.12 million, US$18.18 million and US$29 million, respectively. DBS production values also experienced significant changes rising from US$0.07 million to US$0.34 million in 1983, US$0.63 million in 1989, and US$0.91 million in 1996.

In 1997, the contribution of the bamboo sector to the county economy was US$61.21 million, which was comprised of US$40 million from bamboo growing (US$32.24 million from bamboo shoots and US$7.76 million from bamboo timber) and US$21.21 million from bamboo processing (US$10.55 million from shoots and US$10.66 million from timber). Hence, bamboo shoots constituted approximately 71% of bamboo's total contribution to the economy of Linan county, of which 60% is from FBS.

5.1. The comparative economic advantage of FBS production over other land-based products and competition for land between these products

The new role of bamboo in the local economy is an outcome of the comparative economic position of FBS with respect to other land-based products, such as rice, tea, and silk. The constant price indices (base year 1981), area, and production of FBS, DBS, rice, tea, and silk cocoon are given in Figs. 1–3, respectively. The FBS prices increased at a higher rate than increases in other product prices. The FBS price index in 1996 was 1945.2 while the next highest price index was 446.0 of rice. The price index of FBS decreased slightly in 1990 and 1995, however, these declines were in real price terms. Current prices for 1990 remained similar to 1989 prices but increased in 1995. In 1990, every product price dropped. For tea this decline continued up to 1991, and for silk and rice, the decline continued until 1992. Prices of silk cocoon and FBS again declined in 1995 and silk cocoon and DBS prices declined in 1996. We believe that the relatively higher increase in FBS prices is a result of many factors. First, FBS has shown the characteristics of a superior good, at least among food items, resulting in increased demand for FBS as a result of economic growth. Second, proximity to large markets like Hangzou and Shanghai provided an opportunity to Linan farmers to trade FBS to other regions of China. Third, complete withdrawal of state control, in 1990, from FBS market allowed market interactions between demand and supply to determine prices. Fourth, the new covering technology (explained in Section 4.3) made fresh shoots available during the Spring Festival, when consumers are willing to pay high prices. The distinct contributions of these factors to the FBS price index are observable during three periods. In the first phase (1983–1987), when only increased demand was a factor, FBS price index increased from 129.7 to 227.5. In the second phase (1988–1990), when increased demand and the widening of markets (due to the entry of private enterprises) were present, FBS price index increased up to 516.6.

But, in the third phase, when all four factors were present, price index has shown a drastic increase reaching 1945.2 in 1996. In the case of tea, DBS, rice, and silk, demand was not affected to the same extent as that of FBS, and their pricing mechanisms and market characteristics further put them in a disadvantageous position compared to FBS. Pricing mechanisms of these four products demonstrate a different mix of market and government controls. Rice is under the quota system, and hence, there are quota prices and above-quota prices fixed by the state. Silk prices are totally controlled by the state and farmers can only sell to the State Marketing Cooperatives. DBS and tea remained under state control up to 1990, and post-1990, prices were determined by the market. However, tea and DBS are mainly export products, hence prices are dependent on world market prices. These factors contributed to substantially higher rates of price increases of FBS as compared to other land-based products. The high prices of output but the same prices of inputs and increased yields of FBS put FBS in a comparative economically advantageous position. The average benefit-cost ratios[5] and net financial returns per hectare for different crops are given in Table 1. FBS with covering technology has the BC ratio second to cocoon production, but net returns from cocoon production are lower than that of FBS.

Rice, FBS, and mulberry plantations (cocoon production) are grown on good arable land while DBS and tea on mountainous land. Hence, FBS competes with rice and silk and DBS with tea for land resources. However, there may be a competition between FBS and all other crops for labor and capital. Due to higher monetary returns from FBS compared to rice, the land competition between these two crops resulted in a continuous increase in land area under FBS. Fresh bamboo shoots area reached 7333 ha in 1996 from 1867 ha in 1983, and rice area decreased to 18 620 ha in 1993 from 30 640 ha in 1983. However, while there is no apparent competition between FBS and silk, there is some competition between rice and silk. The area under mulberry plantations (for silkworm fodder) has increased from 1440 hectares in 1983 to 2365 ha in 1994, but a decreasing trend in 1995 and 1996 reduced it to 1826 ha. An interesting feature is that area under

[5] Farmers are mainly concerned about the current year's costs and returns. Hence, BC ratios and net returns are calculated for annual costs and returns. However, even for the full rotation period of 20 years, the relative economic position of FBS with respect to other products does not change.

Table 1
Benefit cost ratios and net financial returns per hectare for bamboo products and other land-based products

Products	Net financial returns (US$/ha)	Benefit cost ratio (1)[a]	Benefit cost ratio (2)[b]
FBS without covering technology	4273	2.4	2.0
FBS with covering technology	13 164	3.6	3.3
Silk cocoon	11 745	6.0	5.5
Rice	1736	2.0	[c]
Tea	1222	1.6	1.2
DBS	409	1.7	[c]

[a] Benefit Cost Ratio (1): BC ratio (1) and net financial returns are for well-established plantations, normally older than 5 years. In these calculations, establishment costs of these plantations are not included. In the case of tea and DBS, these costs are irrelevant to farmers because they received established plantations from the collective. However, farmers do incur establishment costs for FBS and Mulberry plantations.

[b] Benefit Cost ratio (2): These are based on total inputs and outputs for a rotation period of 20 years (details of calculation are available in Kant and Chiu, 1999).

[c] Not relevant.

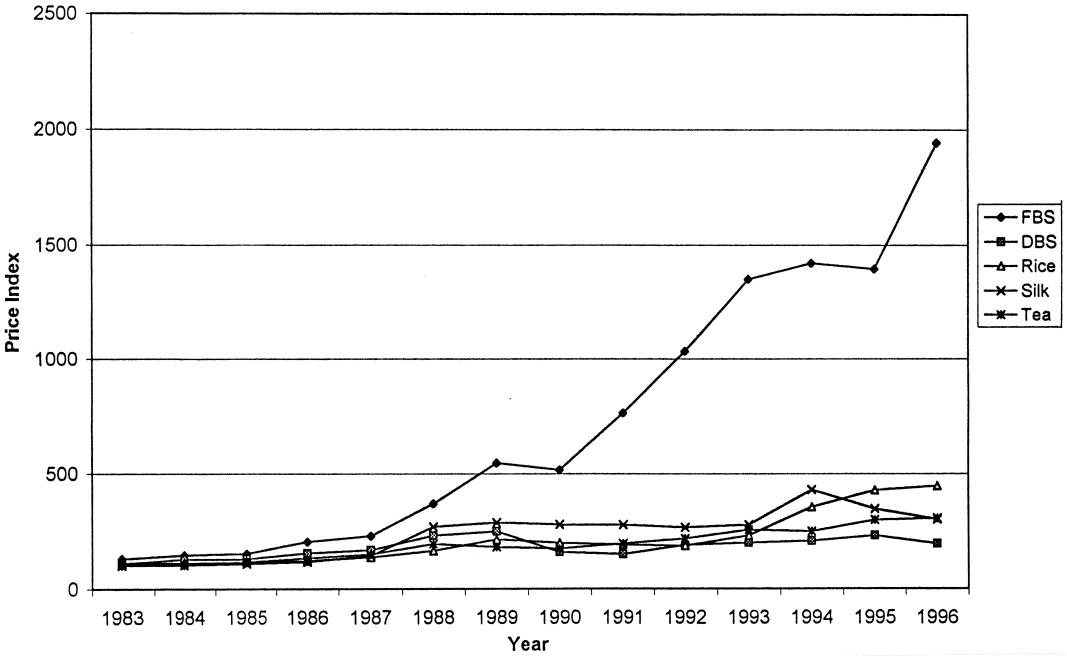

Fig. 1. Price indices of fresh bamboo shoots, dry bamboo shoots, rice, tea, and silk cocoon for the Linan County, China.

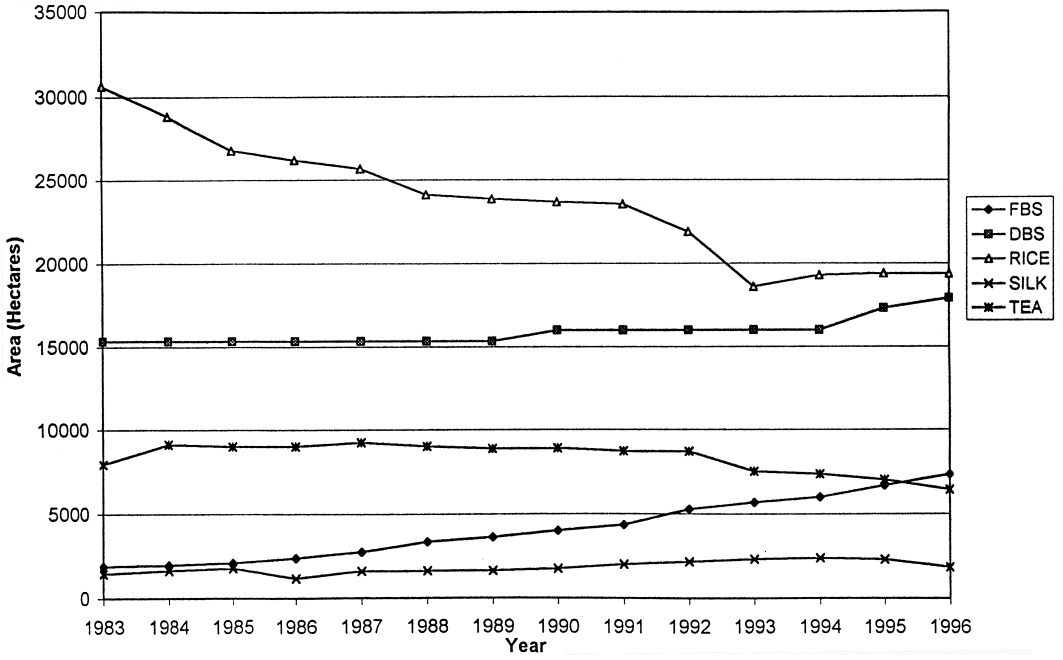

Fig. 2. Land area under fresh bamboo shoots, dry bamboo shoots, rice, tea and mulberry plantations in the Linan County, China.

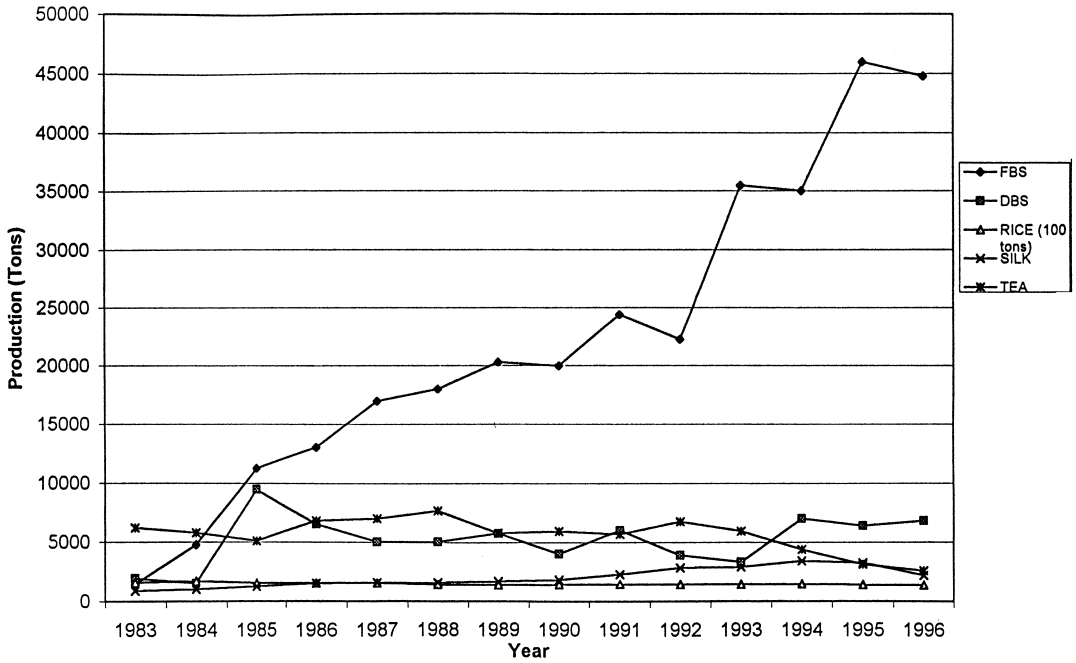

Fig. 3. Production of fresh bamboo shoots, dry bamboo shoots, rice, tea, and silk cocoon in the Linan County, China.

rice decreased despite the increase in rice prices, and area under FBS increased even during the period when there was a decline in prices of FBS in 1990 and 1995. The main reason seems the comparative advantage of FBS over rice, and, hence, even a small decrease in FBS prices could not deter local farmers from converting more area to FBS growing. In addition, the passive approach of local governments, due to rice quotas being low compared to rice production, towards conversion of agricultural land to bamboo production is also an important factor to increases in FBS area. However, the significantly higher price index of FBS (3–4 times) does not pose a problem to area under mulberry plantations that is attributable to four factors. First, the financial returns per unit of land area from FBS and silk are not much different even after the introduction of the new covering technology, and returns from FBS without the covering technology are less than half of the returns from silk. At the same time, BC ratio of silk cocoon is higher than that of FBS. Second, cocoon production is more labor-intensive compared to FBS, and hence, demand on the land resource is less. Third, almost the entire family contributes to the process of silkworm rearing, and this allows various members to sporadically divert their energy to other tasks. Fourth, cocoon production is a specialized job, and families who have engaged in silk production for long time are restrained by cultural inertia to give up their silk production activities. Hence, area under bamboo plantations for FBS as well as for mulberry plantations increased at the cost of area under rice.

5.2. Bamboo sector reforms, FBS production, and resource allocation

The land area, production, and productivity of FBS indicate marked differences during the three periods of 1983–1987, 1988–1990, and 1991–1996. The area under FBS increased at a rate of 216, 422, and 555 ha/year, respectively, during these three periods. These different rates of increase indicate that the economic incentives, due to residual income, created by the HRS, as well as the economic incentives created by industrial re-

forms and market reforms, have different impacts on the area under FBS. As mentioned above, FBS prices were state-controlled until 1987. In 1987, opening of the bamboo-based processing sector to private enterprises increased demand for FBS, and thus, despite prices remaining under state control, there is a marked difference in the increase in prices in 1988 and 1989 as compared to the previous years. Hence, increased demand and higher prices created economic incentives for the farmers to bring their land under FBS cultivation. After 1990, when the state withdrew from the bamboo market, prices jumped by US$0.36 (3 yuan)/kg in 1 year, and a similar trend continued in later years, thus reinforcing the price incentives to farmers. Following McMillan et al. (1989), we could be inclined to say that an annual increase of 216 ha of FBS area is attributable to economic incentives due to the HRS, and 206 ha and 319 ha to price incentives during 1988–1990 and 1991–1996, respectively. However, in the first period (1983–1987), economic incentives due to HRS and cash incentives worked together. In the last period (1991–1996), price incentives due to market reforms and economic incentives due to new technology acted together. In addition, extension activities contributed throughout the whole period. Similarly, an assumption, similar to McMillan et al. (1989), that economic incentives due to the HRS would be exhausted by the end of 1987 would be unrealistic Hence, with the given data, it is not possible to separate out the effects of each reform and incentive. We, based upon our discussions with forestry bureau officials, intend to conclude that during the 1983–1987 period, increases in FBS area were due to economic incentives from the HRS and cash incentives. During the period of 1988–1990, the HRS and price effect contributed almost equally, and that during the 1991–1996 period, the contribution of the price effect, coupled with new technology, and HRS were approximately 60 and 40%, respectively.[6]

[6]Assuming that due to the continuous changes in land tenures, the annual contribution of the HRS incentives to increased FBS area remained the same over the total period (1983–1996).

The real effect of reforms on the local economy is reflected in the production of crops. FBS production increased continuously from 1420 t in 1983 to 44 799 t in 1996. The production of rice is cyclical, showing peaks of 168 235 t in 1984, 145 730 t in 1991, and 145 721 t in 1994, and troughs of 139 818 t in 1989, and 142 260 t in 1993. However, the rice production level of 1984 was never regained. The production of silk has increased continuously from 886 t in 1983 to 3386 t in 1994, and decreased to 2171 t in 1996. In the production process, resource allocation is an important factor, and land productivity (production per unit land area and not the productive capacity) can provide some indications of resource allocation. The productivity of rice increased from 5.07 to 7.64 t/ha in 1993, and then slightly dropped to 7.08 t/ha in 1996. The productivity of silk cocoon has almost continuously increased from 0.61 to 1.43 t/ha in 1994 and then dropped to 1.19 t/ha in 1996. These increases in productivity indicate continuous improvement in resource-use by farmers. In the case of rice, farmers diverted approximately one-third of their land to other economically better uses, and allocated other resources, such as labor and capital, more efficiently. The case of silk supports the hypothesis that even in the situation of a totally state-controlled product market, agents can use their production factors efficiently. The productivity of silk cocoon production is dependent upon the productivity of mulberry plantations with respect to leaf production, as well as to the cocoon rearing process. Hence, we attribute a major portion of efficient production to efficient labor use. Therefore, the increase in productivity of silk is an indication that people are efficiently organizing their labor resources after the implementation of the HRS.

During the period of 1983–1987, FBS production increased at a rate of approximately 3887 t/year, and land productivity[7] increased from 761 to 8675 kg/ha. Hence, the efficient use of all inputs, not only increased amount of land, but contributed to the increased production. In the 3-year period between 1988 and 1990, FBS production increased at a slower rate of 1667 t/year in 1988 and 1989, and in 1990, production de-

creased. Productivity decreased in all 3 years, and reached 7141 kg/ha in 1990. Hence, the increase in land resources was not matched by the required increase in other resources. In the period of 1991–1996, there is an interesting pattern in alternate years. Comparative analysis of the production and productivity of odd years (1991, 1993, 1995) and even years (1992, 1994, 1996) shows an increasing trend. Production increased from 19 995 t in 1990 to 46 000 t in 1995, indicating an increase of 5200 t/year, significantly higher than the rate of increase in the first two periods. The productivity in even-numbered years increased by 796 kg/ha and by 1474 kg/ha in odd-numbered years. The average annual rate of productivity increase is 1978 kg/ha between 1983 and 1987, with increases of 737 kg/ha in the odd-numbered years and 265 kg/ha in the even-numbered years between 1990 and 1996. The higher increase in the first period (1983–1987) is due to the inefficient allocation of resources prior to land reforms, and higher incentives due to the Household Responsibility System. In the last period (1991–1996), it seems that the resource use mechanism was influenced by the new technology. The slow rate of growth in even-numbered years suggests that the amount of land brought under the new covering technology in the first year (1990) was less than the amount of land in 1991, the second year of the introduction of this technology. This biannual nature is due to the use of the new covering technology, in the same bamboo land area, in alternate years, done to maintain the productivity of land. The annual increase in productivity indicates that the efficiency of using covering materials is increasing.

5.3. Bamboo sector reforms, DBS and bamboo timber production, and resource allocation

The current price of DBS, during three periods, shows the similar trend as in the case of FBS, except for a decrease in prices in 1990 and 1991. However, the increase in DBS prices is marginal. In 1988, industrial reforms and improvements in shoot quality through a new drying process contributed to a sudden increase in prices. DBS prices decreased in 1990, similar to other products and this is attributed to the Tianamen Square incident. Dried bamboo shoots are an export crop whose foreign market could not recover immediately after this incident. Fresh bamboo shoots are mainly traded internally within China. Thus, DBS prices continued a decreasing trend in 1991 while FBS prices increased. Dried shoot prices began increasing again in 1992 and have shown steady increase. The Tianamen Square incident seems to have a marked impact on the relative price indices of tea and DBS. Tea is also one of the export crops of China but it has a more diverse foreign market than DBS from Linan County, which are mainly exported to Japan. The impact of Tianamen Square has been that the price index of DBS remained lower than that of tea from 1990 to 1996 while prior to 1990 it was always higher than that of tea.

The DBS area (area harvested for DBS) remained constant at 15 333 ha from 1983 to 1989, increased to 16 000 ha in 1990 and remained at 16 000 ha up to 1994. In 1995, DBS area changed to 17 333 ha and in 1996 to 17 933 ha. The tea area reduced continuously from 1984 to 1996 except in 1987. These two different patterns of change in area indicate that the reduction in tea area is not an outcome of the competition between tea and DBS. However, the production patterns of tea and DBS indicate some competition for other resources, specifically for labor. Production and productivity of DBS do not show any trend except both showing the peak values in 1985. With respect to prices, there are cases where prices increased, and production and productivity decreased, or vice versa, or moved in the same direction. The production of tea also fluctuated up and down. The price of tea has been increasing, except during the period of 1988 to 1990, but production did not respond to these prices, especially after 1992. But in 9 years out of 13, a reverse trend between the production of tea and DBS is observed (the correlation coefficient

[7] In FBS plantations, production begins in the third year and gradually increases to full production in the fifth year. Hence, the effective area of FBS plantations is calculated assuming 1/3 production in the third year, 2/3 production in the fourth year and full production in the fifth year. The productivity is calculated by dividing total production by effective area.

between the tea and DBS production is −0.40), which indicates some competition for resources other than land. Due to the labor-intensive nature of collection of DBS and tealeaves, and a substantial amount of travel-time to the mountainous areas, there has been competition for labor resources between these two crops. The distinguishable point of DBS is that productivity and production have been more than double, even during the worst years of 1992 and 1993, than during the first 2 years of reforms (1983 and 1984). This indicates better resource allocation after land reforms. Industrial and price reforms do not seem to have had a marked impact on DBS, but land reforms have improved resource allocation. The main reasons may be less overall economic returns as compared to FBS, the tedious nature of the labor required, and the low returns per unit of time invested. Hence, farmers might have viewed growing dried bamboo shoot species as a residual job.

The production of bamboo timber also increased from 3.53 million stems in 1983 to 5.98 million stems in 1987, decreased to 1.68 million stems in 1990, and fluctuated between 1.66 million and 3.05 million during the period of 1991–1996. Bamboo timber is mainly harvested from natural forests, and hence, due to the low inputs required, its benefit–cost ratio is quite high compared to other crops. There is no competition for land between agricultural crops and bamboo timber. It is possible that in the early years of reforms, local people harvested larger quantities of timber, irrespective of the productive capacity of the land, due to uncertainties in reforms. But, once they were assured of continuity of reforms, they harvested sustainable quantities. Competition for limited labor resources and low preference for working in mountainous areas are two limiting forces for bamboo timber production, and land or other reforms have not been able to attract allocation of scarce resources for timber production.

6. The role of the contributions of the bamboo sector to different income groups in a village

In 1987, the total population of the selected 46 households was 181, and comprised of 106 workers and 75 non-workers. In 1997, the total population decreased to 175, 103 workers and 72 non-workers. Gender distribution remained almost equally divided over the 10-year period with 48% males and 52% females in 1997 compared to the 50:50 ratio in 1987. During this period, total household land increased from 24.06 to 26.19 ha, but the land under agricultural crops decreased from 10.63 to 10.03 ha while land under FBS almost doubled from 3.23 to 5.79 ha. Mountainous land also increased marginally by 0.17 ha. The total income of the 46 households increased from US$95 527 to US$122 110, an increase of 28%. Average household income increased from US$2077 to US$2655 and per capita income from US$528 to US$698. The total bamboo income, of 46 households, increased from US$16 768 to US$33 309, an increase of 99%. The contribution of bamboo to the total income increased from 18 to 27% while the contribution of the total primary sector decreased from 42 to 40%. The contribution of the secondary (manufacturing) sector increased from 26 to 40%, but the tertiary (service) sector decreased from 32 to 20%.

6.1. Dynamics of inequalities in household resources and household income

On an aggregate, the economy of these five village groups became more egalitarian over the period of 1987–1997. The Gini coefficients for land and labor resources and income components are given in Table 2. The Gini coefficients of the income from the primary and secondary sectors improved but for the tertiary sector income deteriorated. Inequality in the total household income has been reduced. Hence, in aggregate, the local reforms, in all sectors, implemented during this period have been successful in reducing the income disparities. Bamboo sector reforms have reduced inequalities in bamboo land distribution and income from bamboo products. Gini coefficients indicate that the main contributors to income inequality are the secondary and the tertiary sectors. To confirm this, the relative and absolute inequality weights of different income sectors in total income inequality are given in Table 3. The total weight of agriculture and bam-

Table 2
Gini coefficients of households land and labor resources, and household income from different sectors

Resources/components	Gini coefficients 1987	Gini coefficients 1997
Non-worker population	0.158	0.155
Worker population	0.118	0.119
Total population	0.087	0.090
Agriculture land	0.138	0.110
FBS land	0.324	0.232
Mountainous land	0.216	0.129
Total land	0.150	0.112
Bamboo income	0.250	0.210
Agriculture income	0.269	0.130
Primary sector income	0.207	0.170
Secondary sector income	0.307	0.243
Tertiary sector income	0.356	0.392
Total income	0.155	0.133

boo together remained the same over the 10-year period, but the weight of the primary sector reduced from 42 to 28%; the main contributor is animal husbandry, whose share reduced from 14 to 1%. Hence, even though the Gini coefficient of bamboo income reduced, its share to the total income inequality increased. However, the increase in bamboo share was compensated by a decrease in the agricultural share. Thus, bamboo reforms have been able to reduce bamboo income inequality, and retain the share of bamboo and agriculture together in the total income inequality at 1987 levels. The weight of the secondary sector increased from 12 to 35%, and the tertiary sector reduced from 44 to 37%. Hence, in 1997, secondary and tertiary sectors are responsible for the major portion of inequality.

6.2. Contributions of the bamboo sector to five income groups (quintiles)

Distribution of land and labor resources among the five quintiles is given in Table 4. FBS area increased (becoming almost double) for all groups except the poorest group. Agriculture land decreased in the second, fourth and fifth quintiles and increased in the first and third quintiles. Similarly, mountainous land decreased in the first three quintiles and increased in the last two quintiles. As land under agriculture crops was reduced

Table 3
Relative and absolute weights of different sectors to household income inequality

Inequality weight	Year	Agriculture	Bamboo	Animal husbandry	Primary sector	Secondary sector	Tertiary sector
Relative weight (%)	1987	20	7	14	42	12	44
	1997	2	24	1	28	35	37
Absolute weight (Gini coefficient)	1987	0.031	0.011	0.022	0.065	0.019	0.068
	1997	0.003	0.032	0.001	0.037	0.047	0.049

by only 0.66 ha (9 mu), a major portion of additional FBS land appears to have come from the new allotment of land from collective lands, and this new allotment of FBS land reduced FBS land inequality. The changes in agricultural land and mountainous land were marginal, thus the reduction in inequalities in these categories was also marginal compared to that of FBS land. However, due to the economic attractiveness of FBS as a crop, and the possibility of contracting limited land in addition to land allocated under HRS, the area under FBS remains characterized by the highest inequality as compared to agriculture or mountainous land.

The sector-wise contributions of income to the different quintiles are given in Table 5. The contribution of the primary sector decreased by 24% in the richest group, increased by 13% in the second group, while in the next three groups, it changed by only 1 or 2%. The contribution of the secondary sector increased while the tertiary sector decreased across all quintiles. Hence, industrial reforms have benefited all income groups, and this observation from Linan is similar to the observations of the entire Chinese economy (Haggblade and Hazell, 1989; Ranis and Stewart, 1993). The main reason of this outcome is the village and township enterprises who get their labor from local communities (Meng, 1990).

In the case of the primary sector, the contribution of agriculture decreased but the contribution of bamboo increased in all groups. The total contribution of bamboo increased from 18 to 27%, a different outcome from Ruiz-Perez et al. (1999) where the contribution of bamboo remained almost the same over the 6-year period. In 1987, the bamboo contribution was highest (18%) to the two lowest quintiles, and it continuously decreased to 9% for the highest quintile. In 1997, the contribution of bamboo became the highest to the second (33%) and the fourth quintiles (32%), and the poorest group received 26% while the richest group received 22%. In terms of percentage change, the second quintile has the highest increase (11–33%) followed by the fourth quintile (18–32%), and the poorest quintile also has an increase of 8% while the richest quintile has an increase of 13% of their income from bamboo. Hence, even though the increase in bamboo income may be the highest to the second quintile, but the poorest group still gets 26% and the fourth quintile gets 32% income from bam-

Table 4
Distribution of land and labor resources among five income quintiles

Quintiles	Year	Labor resources		Land resources			
		Non-workers	Workers	Wet land (Agriculture land)	Dry land (FBS land)	Mountain land	Total land
First	1987	7	8	11.2	6.1	19.1	36.4
	1997	3	11	16.1	11.5	12.0	39.6
Second	1987	9	20	24.9	7.5	33.9	66.3
	1997	12	23	23.0	15.0	25.0	63.0
Third	1987	11	22	24.7	6.6	28.8	60.1
	1997	15	19	28.7	15.1	28.0	71.8
Fourth	1987	21	23	38.9	7.7	25.0	71.8
	1997	17	17	32.1	28.1	36.0	96.2
Fifth	1987	27	33	59.7	20.5	46.1	126.3
	1997	25	33	50.6	17.2	54.4	122.3
Total	1987	75	106	159.4	48.4	152.9	360.9
	1997	72	103	150.5	86.9	155.5	392.9

Table 5
Income contributions of different sectors to five income quintiles[a]

Quintiles	Year	HH	Income (US$)	Share of different sectors (percentage)				
				Bamboo	Agriculture	Primary	Secondary	Tertiary
First	1987	4	17 438	9	21	51	5	44
	1997	4	23 491	22	7	27	35	38
Second	1987	6	20 142	11	8	27	38	35
	1997	7	25 703	33	7	40	48	12
Third	1987	7	18 159	15	11	42	24	34
	1997	8	24 424	23	9	43	44	13
Fourth	1987	10	19 283	18	18	44	22	34
	1997	10	23 557	32	10	46	31	23
Fifth	1987	19	20 506	18	16	46	37	17
	1997	17	24 935	26	16	45	41	14
Total	1987	46	95 528	18	15	42	26	32
	1997	46	122 110	27	9	40	40	20

[a]*Note*: Household being the unit, the income of each quintile is not exactly the same, but it is closest to 20% of the total income.

boo. Therefore, in this case, the contribution of bamboo is still critical to the poor section. Even though, in 1997, bamboo contributed 22% income to the richest quintile, but out of four households who were in this quintile in 1987, only one household was able to maintain placement in this quintile in 1997. Hence, the analysis of the contribution of bamboo to different income groups is incomplete without understanding the movements of households across income groups.

6.3. Returns from bamboo sector and movement of households across income groups

Only one household could maintain its status in the richest group. Similarly, two out of six, one out of seven, four out of 10, and 10 out of 19 households remained static in the second, third, fourth, and fifth income quintiles, respectively. One household jumped from the poorest to the richest group. Other households were seen to shift up and down across quintiles: 28 households moved from their original income group. In the case of single household that moved from the poorest to the richest group, bamboo contributed 84% of the total income in 1997, which was an increase of seven times compared to the bamboo contribution in 1987. In the case of two households who moved up by three income groups, the dominant contributor was the secondary sector, but income from bamboo was also almost doubled. In the case of three households, who all shifted up by two income quintiles, the primary, secondary, and tertiary sectors played a major role in one household each, and the contribution of bamboo remained either at the same level or increased marginally. The households that experienced a shift into lower income groups were influenced by fluctuations in income from animal husbandry, secondary and tertiary sectors, while the contribution of bamboo varied marginally. The 10 households who remained static in the poorest class, the 'poorest of the poor', are analyzed in further detail to dissect the impacts of bamboo sector on this group.

6.4. Contributions of the bamboo sector to the 'poorest of the poor' households

The ratio of workers to non-workers (1.1) for

this group is less than that of all the households (1.4), which adversely affects land allocation to these households, as well the potential for income from other sources. The total land to these households decreased from 4.79 ha in 1987 to 3.93 ha in 1997. Even bamboo land decreased from 0.79 ha (11.9 mu) to 0.57 ha (8.5 mu), but the actual distribution of bamboo land did extend from only six households to all 10 households. The total income of these 10 households increased from US$10 915 to US$14 764, a 35% increase vs. a 28% increase at the village level. The contribution of bamboo almost doubled from US$1760 (spread over four households) to US$3333 (spread over eight households). This is the same level of increase as at the village level. The contribution of bamboo to the total income increased from 15 to 23%, and agriculture contribution decreased from 18 to 13%. Thus, this poorest section received the same share of bamboo income (23%) as that of the third quintile. Hence, even with limited bamboo land resources, the proportional change in returns from bamboo to this group has been equal to the change at the aggregate level. The smaller contribution of bamboo to total income is not due to the unimportance of bamboo to this group, but rather due to a bias in county forestland allocation policies, which favor a total number of workers over the total number of people in a household.

Hence, increased bamboo income has benefited the poor as well as the rich, and the distribution of bamboo income is not biased in favor of the middle class (as found in Anji County). Bamboo income has also played a critical role in moving many households from the poorer classes to the richer classes. However, if households are moved to the richer classes due to the contribution of bamboo income, this does not necessarily mean that bamboo has become less important to poorer people. The share of bamboo to poorest of the poor group is less than that to other groups due to the demographic composition of these households and demographic factors based land allocation policies. Hence, it is not the case that bamboo is not a poor man's product, but rather land policies have restricted the returns to this group.

7. Final comments

In Linan County, bamboo sector reforms and other initiatives have enhanced the role of the bamboo sector in the local economy. However, the impact of these reforms has been mainly through FBS that raises the question of optimality of uniform land tenures for all forestlands. Hence, the local governments should extend their forestland tenure experiments beyond economic incentives and tenure security, and should include the basic economic differences in the production of different products and should examine different land-tenure arrangements for lands under different types of forests and forest products.

The contribution of the bamboo sector to the poorest group is different in Linan county than that in Anji County. Hence, the hypothesis of using bamboo to improve the economic condition of poor people cannot be rejected on the basis of one or two case studies. The contribution of bamboo to different income groups will be the product and context specific. A longer rotation period of bamboo timber, compared to that of FBS, might have excluded the poor people in Anji from the benefits of bamboo. Thus, the outcome of the Anji County study should be read with the utmost caution. In Linan, FBS have benefited every farmer, but FBS remain crucial to the poorest farmers due to their heavy dependence on the primary sector. If the share of the bamboo sector to the poorest of the poor has not increased to the same level as higher groups, it is due to the adverse effect of forestland reforms on the households who have less workers than non-workers as compared to that of other households. Hence, to bring such households on equal footing, forestland policies must either be modified or some other financial measures should be started.

Finally, bamboo sector reforms have been able to reduce the inequality in bamboo land and bamboo income, but the share of bamboo income in the total income inequality has increased. Hence it may be desirable, at least in the long term, to keep the overall income inequalities in sight, rather than the inequalities in the bamboo

contributions, when designing bamboo land or forestland tenure systems.

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