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World Development Vol. xx, pp. xxx–xxx, 2017

http://dx.doi.org/10.1016/j.worlddev.2016.12.019

Oil Palm Adoption, Household Welfare, and Nutrition Among Smallholder Farmers in Indonesia

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Summary. — Oil palm is one of the most rapidly expanding crops throughout the humid tropics. In Indonesia, the expansion is largely driven by smallholder farmers. While recent research has studied effects for the environment and climate change, socioeconomic impacts in the small farm sector have hardly been analyzed. Here, we address this research gap by analyzing effects of oil palm adoption on farm household living standards and nutrition in Sumatra. Using survey data and econometric models, we estimate average impacts, impact pathways, and impact heterogeneity. Results show that oil palm adoption improves household living standards and nutrition. Mean impacts on food and non-food expenditures, as well as on calorie consumption and dietary quality, are all positive and significant. A sizeable part of the total effects is attributable to oil palm adopters expanding their farm size rather than realizing higher profits per hectare. Oil palm has lower labor requirements than alternative crops (especially rubber), so that adopting farmers are able to manage larger land areas. Labor saved through switching from rubber to oil palm is also used to increase off-farm incomes. Impact heterogeneity is analyzed with quantile regressions. We find positive effects of oil palm adoption across the entire expenditure distribution. However, the absolute gains in total expenditures and non-food expenditures are larger for the better-off, suggesting that oil palm may contribute to rising inequality.

Keywords — Non-food cash crops, oil palm expansion, smallholder livelihoods, quantile regression, Indonesia

1. INTRODUCTION

Oil palm is one of the most rapidly expanding crops throughout the humid tropics. Major reasons for increased palm oil production are rising demand for vegetable oils and biofuels, favorable government policies in producer countries, as well as the crop's superior production potential and economic profitability compared to alternative land uses (Carrasco, Larrosa, Millner-Gulland, & Edwards, 2014; McCarthy & Cramb, 2009; OECD & FAO, 2011; Sayer, Ghazoul, Nelson, & Boedhihartono, 2012). Over the last two decades, the area under oil palm has more than doubled, production quantities have even quadrupled (FAOSTAT, 2016). Over 85% of the world's palm oil production originates from Indonesia and Malaysia, both offering favorable agro-ecological conditions paired with relative abundance of land and labor. The massive expansion of oil palm has contributed to land-use changes with far-reaching environmental and socioeconomic consequences.

While the environmental consequences of the oil palm boom have received considerable attention in the literature (Buttler & Laurence, 2009; Carrasco et al., 2014; Danielsen et al., 2009; Koh & Lee, 2012; Margono, Potapov, Turubanova, Stolle, & Hansen, 2014; Wilcove & Koh, 2010), empirical studies on socioeconomic effects remain scarce. This is surprising, especially because smallholder farmers are often directly involved. In Indonesia, the world's leading producer of palm oil, smallholders account for 41% of the total oil palm area and for 36% of total production (ISPOC, 2012). Smallholders engage in oil palm cultivation either under contract with public or private companies, or as independent producers without external assistance (Euler, Schwarze, Siregar, & Qaim, 2016; Zen, Barlow, & Gondowarsito, 2006). If the current trend continues, smallholders are expected to dominate the Indonesian palm oil sector in the near future (BPS, 2015).

Whether smallholder farmers can benefit from oil palm cultivation is an open question. On the one hand, income gains from growing this crop could contribute to poverty reduction and wider rural development (Cahyadi & Waibel, 2013; Feintrenie, Chong, & Levang, 2010; Rist, Feintrenie, & Levang, 2010; Sayer et al., 2012). On the other hand, a rising focus on a non-food cash crop with relatively large capital requirements could make farm households more vulnerable and increase income inequality (Cramb & Curry, 2012; McCarthy, 2010; Rist et al., 2010; Sheil et al., 2009). More generally, specialization on cash crops has been criticized for decreasing production diversity, increasing farmers' dependence on markets to satisfy nutritional needs, and higher exposure to price shocks on international commodity markets (Jones, Shrinivas, & Bezner-Kerr, 2014; Pellegrini & Tasciotti, 2014; World Bank, 2007).

Very little empirical evidence on the actual socioeconomic impacts of oil palm cultivation in the small farm sector is available. Feintrenie et al. (2010) and Rist et al. (2010) have discussed possible livelihood implications based on simple gross margin analysis. To the best of our knowledge, only Cahyadi and Waibel (2013) have analyzed welfare impacts of oil palm adoption with econometric models. However, their focus was on comparing oil palm adopters with and without production contracts; no control group of non-adopters was included in the analysis (Cahyadi & Waibel, 2013). We contribute to this thin body of literature by examining the impacts of oil palm cultivation on smallholder livelihoods more broadly, using survey data covering adopters and

*This study was financially supported by the German Research Foundation (DFG) in the framework of the collaborative German-Indonesian research project CRC990. The authors thank three anonymous reviewers and the editors of this journal for valuable comments. Final revision accepted: December 18, 2016.

Please cite this article in press as: Euler, M. *et al.* Oil Palm Adoption, Household Welfare, and Nutrition Among Smallholder Farmers in Indonesia, *World Development* (2017), http://dx.doi.org/10.1016/j.worlddev.2016.12.019

non-adopters in Sumatra, Indonesia. In particular, employing econometric models we analyze the effects of oil palm adoption on household living standards, measured in terms of consumption expenditures. Given that undernutrition is still a widespread problem in Indonesia, [1] we also analyze nutritional effects in terms of calorie consumption and dietary quality. Finally, we analyze impact heterogeneity with quantile regressions. Successful adoption of oil palm requires access to land and capital, as well as knowledge and skills to manage the crop. Hence, impacts are expected to vary across farms, depending on asset and capital endowments.

The rest of this article is structured as follows. Section 2 discusses the conceptual framework with possible impact pathways of oil palm adoption and potential sources of impact heterogeneity. Section 3 describes the study area, the data, and socioeconomic characteristics of sample households. The empirical strategy of impact evaluation with econometric models is described in section 4, whereas the estimation results are presented and discussed in section 5. Section 6 concludes.

2. CONCEPTUAL FRAMEWORK

This section briefly describes potential pathways of how oil palm adoption may affect the wellbeing of farm households, based on the available literature. This discussion provides the conceptual underpinning for the later empirical analysis.

While the adoption of oil palm may affect household incomes through various potential mechanisms, we focus on three pathways that may play a particular role in the local context of Sumatra and that we are able to analyze with the survey data collected. [2] First, oil palm may be more profitable per hectare than alternative crops that farmers grew before (Feintrenie et al., 2010; Rist et al., 2010). Higher expected profitability is often the main reason for farmers to adopt new crops or other types of innovations (Feder, Just, & Zilberman, 1984). If this is true for oil palm, higher farm incomes could be generated from the same amount of land. Of course, if the profit expectations do not materialize—for instance, because of declining palm oil prices—farmers may also end up with lower incomes per hectare. Second, labor requirements between oil palm and alternative crops may differ. For instance, oil palm is less labor-intensive than rubber, the most important alternative cash crop in Sumatra (Drescher et al., 2016; Feintrenie et al., 2010). Labor saved through switching from rubber to oil palm may be re-allocated to alternative household economic activities, thus potentially increasing the income from other farm and off-farm sources. The relevance and magnitude of this indirect income effect from labor re-allocation will depend on the opportunity cost of labor. Third, and related to the previous point, lower labor requirements in oil palm may also allow farms to increase their total land area cultivated. Planting oil palm on degraded forestland or fallow patches is common in some parts of Sumatra, when households have access to sufficient labor and capital (Gatto, Wollni, & Qaim, 2015). While such farm size expansion can lead to further deforestation, it may also contribute to income gains for farmers that have access to additional land.

Concerning nutrition effects, a focus on cash crops such as oil palm may reduce the availability of own-produced foods in farm households (Pellegrini & Tasciotti, 2014; von Braun, 1995). However, many of the farm households in Sumatra do not produce much food anyway, even without oil palm adoption (Gatto et al., 2015). The majority of the non-adopters in the study region are rubber farmers who purchase most of their food in the market (Sibhatu, Krishna, & Qaim, 2015). In this situation, additional income from cash crop production or off-farm sources is likely to improve calorie consumption and dietary quality.

We hypothesize positive income and nutrition effects of oil palm adoption on average. Yet, the effects may not be homogenous across all types of farm households. The magnitude of the income effect will likely depend on a set of socioeconomic characteristics. For instance, farmers with better access to land and capital may find it easier to expand their farms. And better educated farmers may have access to more lucrative off-farm economic activities. Similarly, nutrition effects are unlikely to be the same in all adopting households. Food demand elasticities tend to vary with income and nutrition levels. The effects of oil palm adoption on calorie consumption are expected to be most pronounced at the lower end of the income distribution, whereas the effects on dietary quality may possibly be stronger among the relatively better-off. Such relationships will be analyzed empirically with quantile regression approaches, further details of which are discussed below.

3. DATA, DESCRIPTIVE STATISTICS, AND PROFITABILITY

(a) *Study area and farm survey*

A sample survey of farm households was conducted in Jambi Province, Sumatra. Jambi is one of the hotspots of recent oil palm expansion in Indonesia. Among all provinces in the country, Jambi ranks seventh in terms of cultivated oil palm area (over 0.7 million hectares) and sixth in terms of crude palm oil (CPO) production (around 1.7 million tons per year) (BPS, 2015). A significant part of the total area is cultivated by smallholder farmers.

To obtain a sample with a representative geographic coverage of the main oil palm producing areas in Jambi, we purposively selected five lowland regencies, namely Sarolangun, Batanghari, Muaro Jambi, Tebo, and Bungo. Within these regencies, we used a multi-stage random sampling approach, clustering at district and village levels. We randomly selected four districts per regency and two villages per district. Households in each village were also selected randomly. A mean of 15 households per village was sampled, with the exact number chosen proportional to the village size. Five additional villages, where complementary natural science research was carried out (Drescher et al., 2016), were purposively selected. In these five villages, 83 households were selected randomly. We control for non-randomly selected villages in the statistical analysis.

The total number of household observations in our sample is 683. Out of these, 19 observations were excluded because of stark outliers for key outcome variables. [3] Hence, 664 household observations are used for the econometric analysis, including 199 oil palm adopters and 465 non-adopters. [4] Adopters engage in oil palm cultivation either under contract with public or private companies, or they cultivate the crop independently without contract (Euler et al., 2016; Zen et al., 2006). Contracted farmers receive financial and technical support for plantation establishment and crop management, but the loans received have to be repaid once the crop starts bearing fruits (Zen et al., 2006). Contract schemes were more important in Jambi in the 1990s and 2000s. While they still exist, most of the more recent oil palm adoption and expansion among smallholders occurs independently, without any contracts involved (Euler et al., 2016). In our sample, 68% of the oil palm adopters manage the crop independently, while the remaining 32% have a contract or had one in the past that

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