Economics For Health

The Economics of Tobacco Farming in Indonesia: 4th Wave Tobacco Farmers Survey

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Executive Summary

The tobacco industry continues to share narratives that tobacco farming is a profitable endeavor and that tobacco control policies would adversely affect tobacco farming outcomes and the livelihood of tobacco farmers (Lencucha et al., 2016; Otañez et al., 2009). However, the global tobacco control community has gained important insights into farmer livelihoods and the political economy of tobacco policy that counter these claims with rigorous studies conducted over the past two decades. Some of these studies have used household survey data as part of a larger effort to understand the livelihoods of workers in the tobacco sector and in-depth analysis of policy contexts through interviews and systematic document analysis. Researchers have analyzed tobacco farmers' livelihoods in tobacco-producing countries such as Indonesia, the Philippines, Zambia, Kenya, Zimbabwe, Malawi, and Bangladesh. Thes findings have provided insights into the livelihoods of former tobacco farming, the costs of tobacco farming, the incidence of contract farming, reasons why tobacco farmers grow tobacco, reasons why farmers transition out of tobacco farming, the incidence of poverty among tobacco farmers, and the impact of tobacco farming on farming households' income.

In most cases, even across country contexts, tobacco farming households generate small profits and often incur losses, particularly when the weather does not support tobacco growing conditions. Companies often provide high-interest loans to farming households in the form of inputs and capital, and with the low price received for leaves sold at the end of the season, farmers often struggle to cover these loans. The high cost of production and low returns often lead to cycles of debt and dependency. Even when tobacco farmers generate profits, former tobacco farmers tend to fare better economically owing to better diversification of primary sources of income.

This report presents findings from the fourth wave of data—a continuation of the first three waves—of the Tobacco Farmers' Study in Indonesia. This report analyzes the dynamics of tobacco farming and farmers' livelihoods across periods. Unique to this study, is the comparative analyses between current and former tobacco farmers. The Wave 4 study successfully tracks most former tobacco farmers from the previous survey waves, allowing the study team to analyze a rich panel dataset. The dataset allows us to analyze tobacco and former tobacco farmers' livelihoods in years with unfavorable weather (Wave 1) and relatively favorable weather and rainfall (Wave 2, 3, and 4). In addition, the Wave 4 study was conducted during the Covid-19 pandemic, which added another complex economic dimension.

Figure ES-1. Median total household income per hectare of tobacco and non-tobacco farming across waves, 2016-2022.

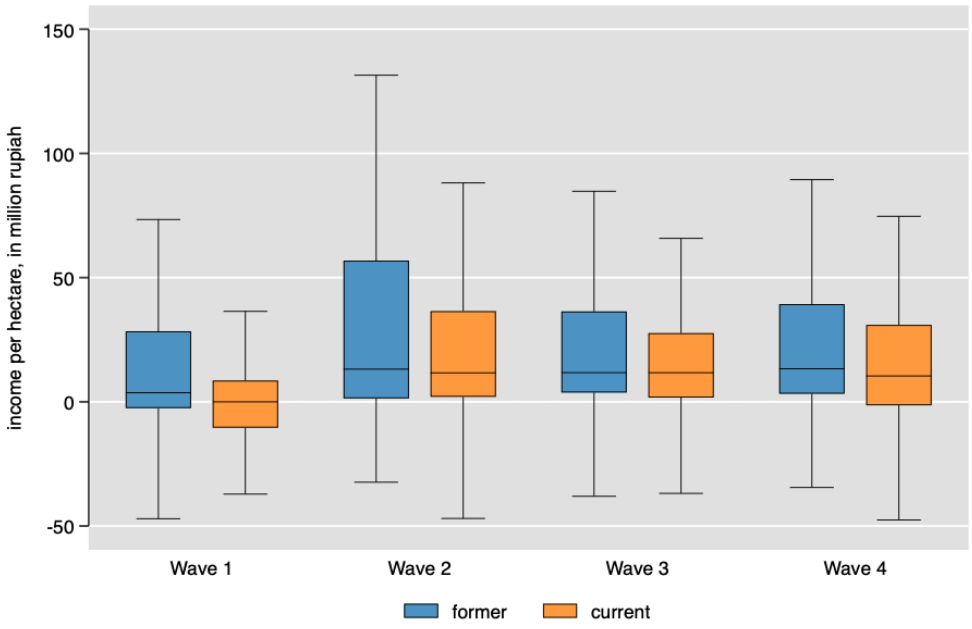


Figure ES-2. Agricultural input costs per hectare of tobacco and non-tobacco farming across waves, 2016-2022.

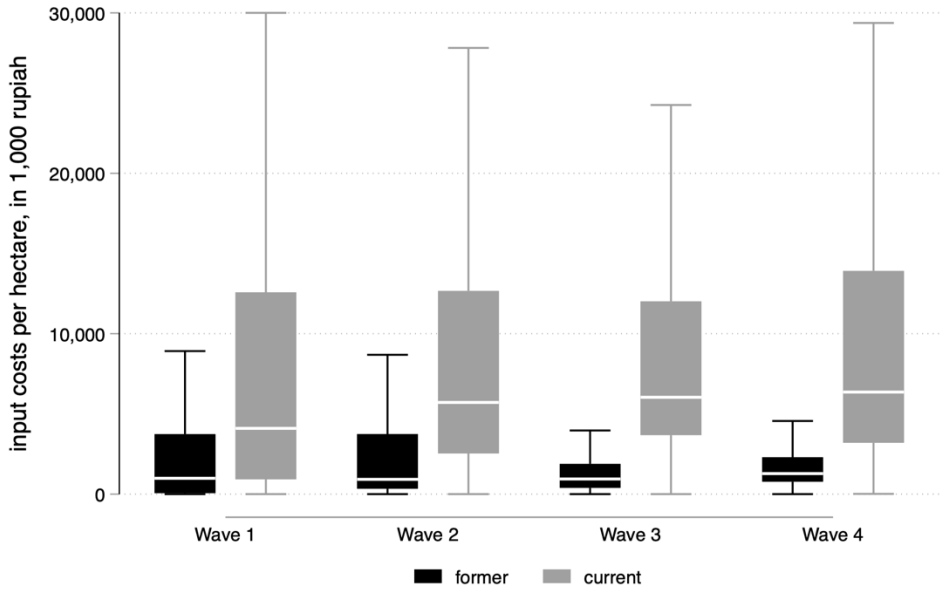
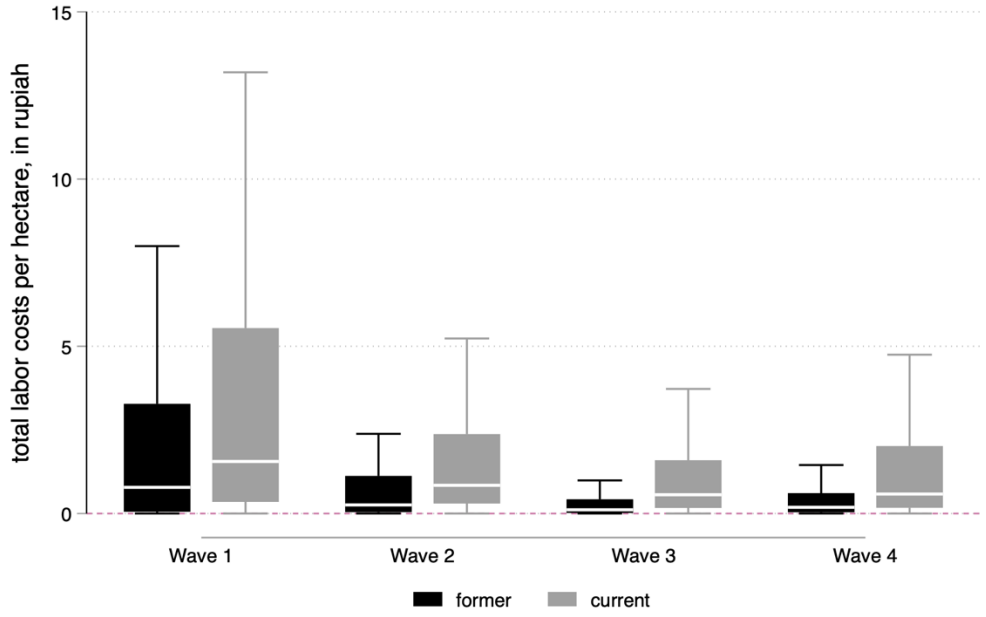


Figure ES-3. Household labor costs per hectare of tobacco and non-tobacco farming across waves, 2016-2022.



The main findings of this study are:

1. The primary reasons for growing tobacco among farmers who continued growing were: familiarity and experience growing tobacco, viewing tobacco farming as a lucrative enterprise, weather, availability of land, the existence of a ready market to sell their crop, and perceiving tobacco as the only viable cash crop.
2. Former tobacco farmers enjoyed higher incomes from non-tobacco crops during the dry season. The favorable farming outcomes among former tobacco farmers were driven by better income diversification than current tobacco farmers. Former tobacco farmers are likelier to engage in enterprise, wage-bearing, and other economic activities. Former tobacco farmers also have better diversification of primary income sources.
3. Although tobacco farmers continued to enjoy a profitable year of tobacco farming, their profit was still lower than that of former tobacco farmers. As shown in Figure ES-1, tobacco farmers' median income per hectare was positive in Wave 4, but slightly lower than the median in the previous wave. The volume of tobacco sold was lower in Wave 4, but prices per kilogram of all tobacco variants were slightly higher in Wave 4 than in the previous wave.
4. Tobacco farmers bear higher farming costs per hectare than former tobacco farmers, as shown in Figure ES-2. Our estimate suggests that tobacco households bear higher input costs per hectare by almost fivefold. In addition, as shown in Figure ES-3, tobacco farming households bear higher household labor costs, nearly three times per hectare, than former tobacco farmers. These statistics suggest that tobacco farming uses more labor than former tobacco farming.
5. Our regression results correspond with previous findings (Sahadewo, Drope, Li, Nargis et al., 2020), where a higher share of land dedicated to tobacco farming correlates negatively with farmers' income. This result

suggests that transitioning out of tobacco farming is not only an economically viable option, but is likely to be more lucrative.

6. Estimated poverty rates among tobacco and former tobacco farmers were higher in Wave 4 relative to Wave 3. Importantly, tobacco farmers' poverty rate was higher than former tobacco farmers. Current tobacco farmers are more likely to receive Family Welfare Cards, which are the basis for receiving various social protection programs offered by the government of Indonesia.
7. Tobacco farmers also reported needing loans. The loans primarily fund inputs (e.g., seeds, fertilizer, equipment) for tobacco and non-tobacco farming. Nearly a quarter of current tobacco farmers reported needing loans to meet their daily needs.

We further develop our recommendations from Wave 3 TFS—which remain relevant—in line with our recent findings.

First, **national and local governments should identify and establish agricultural extension services and support programs to allow tobacco farmers to transition into non-tobacco cash crops** suitable for local conditions and in demand in the local market. The TFS reports suggest that tobacco farmers continue to farm tobacco out of habit and familiarity, which signifies the need for agricultural extension services. Such a service can provide farmers with farming technology for non-tobacco cash crops, insights about farming commodity prices and demand in the surrounding market, and access to buyers. The local government can fund these services and programs using the Dana Bagi Hasil Cukai Hasil Tembakau (Revenue Sharing Funds for Tobacco Products Excise) or DBHCHT and Village Fund (Dana Desa) programs.

Second, the **national and local governments should support improved farming infrastructure in regions with difficult access to water during the dry season**. Difficulty in accessing water during the dry season has been

consistently cited as the primary reason why tobacco is the only viable crop during the dry season. Farming infrastructure may include irrigation systems, deep groundwater wells, and reservoirs. As such, infrastructure may help tobacco farmers transition to non-tobacco cash crops, the local government can tap into the DBHCHT, and since it would improve overall access to water for tobacco and non-tobacco farmers, local officials can also tap into Village Fund programs.

Third, the **government should support the formation of robust farming cooperatives**. In many cases, farmer cooperatives have been shown to improve their members' livelihoods. Cooperatives allow farmers to pool resources and establish market power collectively. The pool of resources enables farmers to purchase essential agricultural inputs in large quantities at lower prices and hire modes of transportation to move farmers' harvests to market. Sometimes, such cooperatives can also provide informal financing to member farmers who need short-term loans. The market power allows farmers to establish their value chain without relying on middlemen.

1 Introduction

The global tobacco control community has learned significantly from the literature about tobacco farmers' livelihoods in the past two decades (Lencucha et al., 2022). Studies have conducted rigorous analysis of data collected on tobacco farmer livelihoods in a growing number of tobacco-producing countries including Indonesia, Philippines, Zambia, Kenya, Zimbabwe, Malawi, and Bangladesh (Chavez, Drope, Li, et al., 2016; Chingosho et al., 2020; Drope et al., 2018a; Goma et al., 2017; Hussain et al., 2020a; Magati et al., 2016a; Setyonaluri et al., 2008). These studies have generated insights into the costs of tobacco farming, the incidence of contract farming (Hussain et al., 2020b; Magati et al., 2019; Makoka et al., 2017a), reasons why tobacco farmers grow tobacco (Appau, Drope, Goma, et al. 2019; Appau, Drope, Witoelar, et al. 2019; Sahadewo, Drope, Li, et al. 2020), reasons why farmers transition out of tobacco farming (Sahadewo, Drope, Li, Witoelar, et al., 2020), the incidence of poverty among tobacco farmers (Sahadewo et al., 2024), and the impact of tobacco farming on income (Sahadewo, Drope, Li, Nargis et al., 2020).

These studies provide evidence that counters one of the tobacco industry's main narratives that tobacco farming guarantees economic livelihoods for tobacco farming households. The studies find that, in most cases, tobacco farming households generate small profits, and many generate losses, notably when the weather does not support tobacco growing conditions. This evidence also counters the idea that tobacco control policies would have a negative effect on the livelihood of tobacco farmers since farmers who shifted to other crops actually typically fare better economically. Moreover, a study of tobacco farmers in Indonesia shows that farmers who switched out of tobacco farming fared better economically than those who remained tobacco farmers (Sahadewo, Drope, Kartaadipoetra et al., 2020).

This study is based in Indonesia, the fourth-largest tobacco-growing country in the world. Despite advances made by the Government of Indonesia to strengthen tobacco control measures over time, one of the major obstacles to these public health measures is the perspective that tobacco is an important economic commodity for the country. Although this remains a prominent narrative in the policy sphere—and tobacco farming is concentrated in several districts in West Java, Central Java, and Nusa Tenggara Barat—tobacco farmers only comprise 1.6 percent of the agricultural sector (Rachmat, 2010). The overall contribution of tobacco farming to the Indonesian economy is also quite small at 0.03 percent of the Indonesian GDP (Sahadewo et al., 2018).

This study adds to the literature on tobacco control and the livelihoods of tobacco farmers by analyzing the dynamics of tobacco farming and tobacco farmers' livelihoods across periods. This study also contributes to the literature by analyzing former tobacco farmers' economic outcomes and livelihoods. This study is the fourth wave of the tobacco and former tobacco farmers survey, continuing the previous waves (Drope et al., 2018a; Sahadewo, Drope, Kartaadipoetra, et al., 2020; Sahadewo et al., 2021). We implemented a tracing protocol to re-interview the 660 tobacco and former tobacco farmers from the previous survey waves. We implemented this protocol to maintain the sample representativeness of the population of tobacco and former tobacco farmers in tobacco-producing districts in the provinces of East and Central Java.

On average, tobacco and former tobacco farmers enjoyed a profitable farming year in the Wave 4 TFS as they gained positive per-capita household income. However, key differences between former and current tobacco farmers, as well as negative outcomes of tobacco farming, persist. First, former tobacco farmers gained higher per-capita household income as in Wave 1 and Wave 3. Second, there was still a significant, if not higher, share of tobacco farming households who reported that less than 10 percent of their income was derived from tobacco

farming. This finding shows that the contribution of tobacco farming to household income is, in general, small. Third, most tobacco farmers rely on agricultural activities, and their primary sources of income are less diverse than former tobacco farmers' income sources. Fourth, tobacco farmers bear higher costs per hectare for tobacco farming, not only for the agricultural inputs but also for the labor. Fifth, the share of tobacco farming households living in poverty is generally higher than the poverty rate of the general population and the poverty rate among former tobacco farmers. These findings remain consistent across waves, suggesting that tobacco farming households generally do not fare better economically than households that moved out of tobacco farming.

This study explores other tobacco farming outcomes and various conditions across waves and regions. These findings provide comprehensive knowledge of the dynamics of tobacco farming in Indonesia, offering essential insights into the general challenges of tobacco farming across time.

Lastly, this study contributes to the growing literature on livelihoods of other workers in the tobacco sector, including workers in the cigarette manufacturing sector (Araujo et al., 2018; Sahadewo et al., 2018), traditional *kretek* rollers (Nargis et al., 2018), and clove farmers (Marquez et al., 2018; Suprihanti et al., 2018).

We structure the report as follows. Section 2 discusses research methods, including sampling, survey instruments, sample selection, and data analysis. In Section 3 and Section 4, we present the analysis of socio-economic characteristics and the economics of tobacco farming, respectively. In Section 5, we discuss the measures of households' well-being, such as assets and food security. Finally, we outline our conclusions in the last section.

2 Methodology

2.1 Sampling

We conducted the first wave of this survey in 2016. Our study population comprised the provinces of East Java, Central Java, and West Nusa Tenggara, as these regions are the primary tobacco producers in Indonesia. We selected *kabupaten* (districts) from each province with the highest tobacco production. Our selected districts were Bojonegoro and Jember of East Java Province, Temanggung and Magelang of Central Java Province, and Central Lombok and East Lombok of Nusa Tenggara Barat Province. To ensure a comprehensive representation of burley tobacco farmers, we included the Lumajang district in East Java as an additional sample area. This decision was made to capture a broader diversity of tobacco farming practices and experiences in our study.

Consistent with the methodology employed for the district selection, the *kecamatan* (sub-districts) samples were also chosen based on the extent of tobacco production. The selection process was meticulously carried out using a stratified randomization approach. Within each identified sub-district, we carefully selected three villages with the highest tobacco production levels for the sample. Data collection from the village heads was sought from about 40 tobacco farmers and ten former tobacco farmers. Subsequently, a random selection procedure was applied to secure 20 tobacco farmers and five former tobacco farmers from each village. This meticulous process culminated in a final sample size of 1,350 tobacco farmers and former tobacco farmers for the inaugural Wave 1 of the Tobacco Farmer Survey (TFS).

The Wave 2 TFS was carried out from late 2017 to early 2018. Regrettably, a follow-up survey in West Nusa Tenggara could not be conducted due to financial constraints. From each previously sampled village, we selected 15 households out of the initial 25 per *dusun* (sub-village) from Wave 1. The ratio of tobacco

farmers to former tobacco farmers was maintained at 4:1 for most regions, except for the Lumajang area, where the ratio was adjusted to 1:1 due to the challenges encountered in locating farmers in the region. Remarkably, this comprehensive survey successfully encompassed a total of 660 tobacco farmers and former tobacco farmers in Wave 2.

Between December 2019 and January 2020, we conducted the Wave 3 TFS survey. Throughout the survey, we tried to track as many households as possible as respondents. Despite our best efforts, some households could not be interviewed. As a result, the total number of households interviewed in the second third wave was 656. Between December 2021 and January 2022, we conducted the Wave 4 TFS. Like the previous waves, we made concerted efforts to track previous households. We successfully collected valuable data from 648 households during this wave. We present the number of respondents surveyed in each wave of the study in Table 1. The attrition rates of respondents were relatively low, 0.61% in the Wave 3 TFS and 1.82% in the Wave 4 TFS.

Table 1. Survey respondents by province, district, and sub-district

Province	Municipality	Village	Wave 1	Wave 2	Wave 3	Wave 4
East Java	Bojonegoro	Kepoh Baru	75	45	45	45
		Ngasem	75	45	45	42
		Ngraho	75	45	45	45
		Tambakrejo	75	45	45	45
	Jember	Balung	75	45	45	45
		Kalisat	75	45	45	44
		Pakusari	75	45	45	44
		Puger	75	45	44	45
	Lumajang	Pasirian	75	55	54	54
		Tempeh	75	65	64	65
Central Java	Temanggung	Bulu	75	45	45	45
		Parakan	75	45	44	43
	Magelang	Kaliangkrik	75	45	45	45
		Windusari	75	45	45	41
West Nusa Tenggara	Lombok Tengah	Janapria	75	-	-	-

	Lombok Timur	Praya Timur	75	-	-	-
		Sakra Barat	75	-	-	-
		Sakra Timur	75	-	-	-
Total			1,350	660	656	648

2.2 Survey instruments

The Wave 1 survey instrument was carefully designed by a team of experts with experience surveying farming households in lower-income countries, drawing inspiration from similar surveys conducted in other countries and regions, and augmented with essential data elements derived from the reputable World Bank's Living Standards Measurement Study (LSMS). Renowned for its effectiveness in collecting comprehensive and in-depth data on households' and individuals' economic and social conditions, the LSMS served as a solid foundation for our questionnaire development.

The questionnaire comprises 26 comprehensive sections, covering pivotal topics including household characteristics, livelihoods, income and assets, land ownership and crop production, general tobacco production, tobacco production under contract (if applicable), tobacco marketing, farmers' debts and credits, household food security, and future projections concerning tobacco production and health. The formulation of the survey instrument was further influenced by contemporary research focusing on the political economy of tobacco farming in Sub-Saharan Africa and the Philippines. Esteemed scholars such as Briones (2015), Chavez et al. (2016), Drope et al. (2018), Goma et al. (2015), Magati et al. (2016), and Makoka et al. (2017) have contributed significantly to this area of study, enriching the foundation upon which our survey was constructed.

The Wave 2 TFS utilized a comparable survey instrument with targeted modifications to enhance the precision of variable measurement. Building upon the foundation laid out in the Wave 1 TFS, we introduced specific inquiries in this wave to address critical aspects that demanded further exploration. Notably,

we incorporated questions about symptoms of illness, the utilization of labor for pesticide or herbicide application, and an array of queries concerning the proximity and accessibility of the nearest economic center, thereby gauging market access and opportunities outside the agricultural sphere.

As we progressed into Waves 3 and 4, we refined the survey instrument by introducing five new sections. The first addition was a comprehensive smoking participation section, encompassing two inquiries to investigate the smoking habits of all family members. Secondly, we introduced a section on risk preference, encompassing a series of hypothetical scenarios to assess respondents' attitudes toward risk. The third novel element involved the measurement of general satisfaction, encompassing factors like life satisfaction, happiness levels, and other subjective well-being indicators. Moreover, we delved into assessing subjective well-being and decision-making processes within the household. These inclusions were designed to enhance the richness and depth of the data collected, enabling us to comprehensively understand the intricate dynamics at play within the context of tobacco farming households.

2.2.1 Computer-assisted personal interviewing

The increasing trend towards adopting computer-based data collection methods, as observed by (Smith & Kim, 2015), prompted us to adapt the Tobacco Farming Systems (TFS) study from Wave 1 to Wave 4 by employing the computer-assisted personal interview (CAPI) method, implementing through a CSPro-based program developed in collaboration with SurveyMeter, our esteemed survey implementation partner.

The strategic implementation of the CAPI method in the TFS study brought numerous invaluable advantages. Firstly, the CAPI mode facilitated the seamless design of a complex survey, owing to the substantial number of sections and questions comprising the TFS. This intricate survey design encompassed

meticulous checks for missing data, ensured data consistency, and enabled efficient and accurate data recapitulation. Secondly, integrating complete audio recordings of each interview proved instrumental in maintaining rigorous quality control and providing an avenue for revisiting the data. These audio records served as a safeguard to ensure the fidelity and credibility of the information gathered. Thirdly, the CAPI method facilitated the seamless integration of interview data from Wave 1 to Wave 4, enhancing our ability to track changes and discern trends over time with heightened accuracy and precision. This integration has been instrumental in drawing more robust conclusions from the accumulated data, ensuring more informed policy and decision-making processes. Lastly, the CAPI mode was pivotal in establishing a secure and reliable data backup protocol. Leveraging an integrated system, we were able to efficiently store and safeguard the collected data, ensuring that it is readily accessible for archival purposes and for future in-depth analysis.

2.3 Sample selection

In the context of panel data collection, we were presented with two sample selection alternatives to consider. The first option involved analyzing the farmer data gathered across all waves in our study, including those who were only surveyed in the first wave. Alternatively, the second option entailed analyzing farmers who were visited in all four waves. However, due to budgetary constraints, we encountered the necessity of excluding the West Nusa Tenggara sample in Waves 2, 3, and 4 during the implementation of this study.

We conducted logistic regression analyses during Wave 2 to investigate this limitation. The primary objective of this test was to meticulously examine the potential correlation between the likelihood of farmers being revisited and the characteristics observed in Wave 1. Our findings revealed no statistically significant correlation between these variables (Sahadewo, Drope, Kartaadipoetra et al., 2020).

Furthermore, it is imperative to emphasize that despite excluding the West Nusa Tenggara sample in Waves 2, 3, and 4, our sample selection remains representative of the broader population of tobacco farmers in Indonesia, particularly within the Java region where most farmers live. The sample representativeness underscores the reliability and robustness of our study's findings. It enhances our ability to draw accurate inferences and make well-informed policy recommendations about the context of tobacco farming systems in Indonesia.

2.4 Data analyses

We conducted two analyses of the data we collected. First, we used descriptive analysis to investigate the various characteristics of the farmers. These include socio-demographic characteristics, details related to agricultural and non-agricultural output, their work, information on household characteristics and life, aspects of subjective well-being, and their perceptions of key relevant dynamics. We also conducted a multivariate regression analysis to identify correlations and relationships between tobacco farming and income, tobacco growing contract correlations, and green tobacco sickness (GTS) correlations.

3 Farmers' Characteristics

3.1 Sociodemographic profile

Table 2 provides a comprehensive overview of the distinct characteristics exhibited by current and former tobacco farmers across all waves of our study. Most of our sample participants—94.60 percent of the total sample—were male heads of farming households, highlighting the prevalent gender composition in the farming community (or at least the gender of those who self-identified as farmers). More than half of the respondents were middle-aged and between 36 and 60 years old. Consistently, most participants were married, and this marital status proportion remained relatively stable across all four survey waves.

Respondents with primary school education represent the largest percentage, with 36.88 percent of farmers having completed primary education and 35.96 percent having partially completed it. Moreover, 12.50 percent of the sample possessed a junior secondary school education.

Notably, a substantial portion of our sample, both current and former tobacco farmers, primarily engaged in agricultural activities. However, a notable trend emerged as we observed a decrease in the percentage of farmers with agriculture as their primary activity from the first and second waves to the fourth wave. This decline coincides with an increase in the percentage of farmers transitioning into retirement during the fourth wave. On the other hand, around 16.98 percent of the sample relied on non-agricultural activities, with a higher proportion found among former tobacco farmers.

Table 2. Characteristics of former and current tobacco farming household head

	Wave 1			Wave 2			Wave 3			Wave 4		
	Current	Former	Total	Current	Former	Total	Current	Former	Total	Current	Former	Total
Gender, in %												
Female	2.89	2.75	2.86	2.73	7.43	3.79	4.31	7.74	5.18	3.05	8.39	5.40
Male	97.11	97.25	97.14	97.3	92.6	96.2	95.69	92.26	94.82	96.95	91.61	94.60
Age (Years), in %												
21-35	11.07	11.37	11.14	8.59	8.11	8.48	6.78	6.55	6.71	4.16	7.37	5.56
36-60	72.08	69.80	71.52	68.95	68.24	68.79	66.53	68.45	67.07	64.54	58.95	62.13
>60	16.86	18.82	17.33	22.5	23.7	22.7	26.69	25	26.22	31.30	33.68	32.30
Marital Status, in %												
Never married	1.01	1.96	1.24	0.20	0.68	0.30	0.21	1.19	0.46	0.28	0.70	0.46
Married	93.84	94.12	93.90	94.34	93.92	94.24	94.25	88.69	92.84	92.52	88.11	90.59
Divorced/ separated	1.13	0.39	0.95	0.59	1.35	0.76	0.21	1.19	0.46	0.55	0.70	0.62
Widowed	4.03	3.53	3.90	4.88	4.05	4.70	5.34	8.93	6.25	6.65	10.49	8.33
Education,[a] in %												
No school	-	-	-	-	-	-	-	-	-	-	-	-
Some SD	39.37	32.16	37.62	43.55	35.81	41.82	40.86	40.48	40.85	35.73	36.36	35.96
SD	39.50	38.43	39.24	33.59	36.49	34.24	35.32	29.17	33.69	40.72	31.82	36.88
Some SMP	2.77	2.75	2.76	4.10	2.70	3.79	2.46	5.36	3.20	3.60	2.10	2.93
SMP	10.06	16.08	11.52	8.98	14.19	10.15	11.09	13.69	11.74	9.70	16.08	12.50
Some SMA	1.01	0.78	0.95	1.95	2.03	1.97	2.67	0.60	2.13	2.49	-	1.39
SMA	4.40	5.10	4.57	4.49	4.05	4.39	4.72	6.55	5.18	5.26	7.69	6.33
Some SMK	0.38	-	0.29	0.59	0.68	0.61	-	1.19	0.30	0.28	-	0.15

SMK	2.01	2.35	2.10	1.37	2.03	1.52	1.85	1.19	1.68	1.39	3.85	2.47
D1, D2, or D3	-	-	-	-	-	-	-	-	-	-	0.35	0.15
Some College	-	0.39	0.10	0.39	-	0.30	0.41	-	0.30	-	-	-
College	0.50	1.96	0.86	0.98	2.03	1.21	0.62	1.79	0.91	0.28	1.75	0.93
Post-Graduate	-	-	-	-	-	-	-	-	-	0.55	-	0.31
Main Activity, in %												
Agricultural work	83.90	71.37	80.86	84.18	75.68	82.27	81.72	64.29	77.29	86.43	70.63	79.48
Non-agricultural work	13.58	22.35	15.71	12.70	22.30	14.85	15.81	27.98	18.90	11.36	24.13	16.98
Home duties	0.13	0.78	0.29	0.59	1.35	0.76	1.03	2.98	1.52	0.28	1.75	0.93
Retired/aged	1.26	1.57	1.33	1.37	0.68	1.21	0.62	1.79	0.91	1.11	2.80	1.85
Unemployed (looking for work)	0.25	1.57	0.57	0.39	-	0.30	0.21	-	0.15	-	-	-
No work	0.88	2.35	1.24	0.78	-	0.61	0.62	2.98	1.22	0.83	0.70	0.77
Observations	795	255	1,050	512	148	660	487	168	656	361	286	648

Notes: The sample from the first wave excludes households from West Nusa Tenggara. [a]The acronyms SD stands for *Sekolah Dasar* (elementary school), SMP stands for *Sekolah Menengah Pertama* (junior middle school), SMA stands for *Sekolah Menengah Atas* (high school), SMK stands for *Sekolah Menengah Kejuruan* (vocational high school), D1/D2/D3 stands for Diploma 1, Diploma 2, and Diploma 3.

3.2 Economic activities and income

We collected livelihood data from tobacco and non-tobacco farming households, encompassing all household members. The analysis revealed that approximately 70.67 percent of individuals from tobacco farming households earned their income from agricultural or non-agricultural activities in the last seven days, compared to 32.96 percent in non-tobacco farming households. Furthermore, a significant percentage of individuals from both household types were engaged in on-farm activities, with 69.98 percent in tobacco farming households and 52.84 percent in non-tobacco farming households. This disparity may be linked to a higher involvement in business-related activities among members of non-tobacco farming households.

Table 3. The primary source of livelihood by self-report: total household members

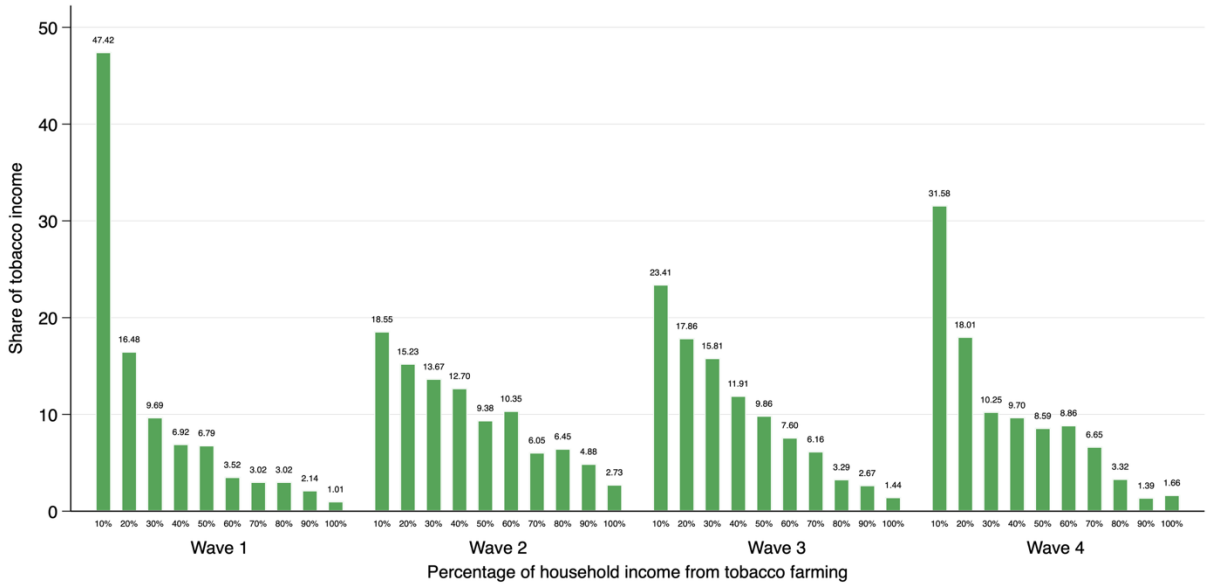
	Current Farmer		Former Farmer	
	N	Proportion (%)	N	Proportion (%)
In the last seven days				
Received payment in agricultural or non-agricultural activities	1,316	70.67	986	32.96
Business (fisheries, livestock)	1,316	25.99	986	31.95
Helped without pay in any kind	1,316	50.91	986	41.99
Worked on this household's farm	1,316	69.98	986	52.84
In the last 12 months				
Participated in tobacco farming	921	95.77	521	-
Participated in non-tobacco farming activities	921	91.53	521	98.85

Note: We use the sample from the fourth wave of the Tobacco Farmers Survey.

The collected data allowed us to analyze the proportion of income derived from tobacco farming activities in tobacco farming households, as depicted in Figure 1. In Wave 1, most households (47.42 percent) reported that less than 10 percent of their income came from tobacco farming. As we progress through subsequent waves, the proportion of income from tobacco farming shows an increasing trend,

resulting in a more pronounced slope in the graph. Notably, there was a significant decrease in households reporting less than 10 percent income from tobacco farming in the second wave, followed by an increase in subsequent waves. However, it is worth noting that the group with the lowest income (10 percent) from tobacco farming still remained the largest across all waves. Income from tobacco farming constitutes only a minor fraction of the total household income.

Figure 1. The proportion of tobacco income to total household income



Note: The sample from the first wave excludes households from West Nusa Tenggara

One of the primary objectives of this study is to investigate the diverse sources of household income across each wave. We define household income as the sum of profits from tobacco farming, non-tobacco farming, household business ventures, and other sources. We then deduct rent and household labor costs from this aggregate income (Drope et al., 2018b; Sahadewo et al., 2021). The inclusion of household labor costs in our analysis is based on the findings of prior research conducted by Chavez et al. (2016), Goma et al. (2015), and Makoka et al. (2017), which emphasize the significance of accounting for

opportunity costs represented by household labor. We adopt the method employed in these studies to calculate household labor costs. Specifically, we multiply the agricultural minimum hourly wage by the number of household members engaged in farm labor. Subsequently, this value is adjusted for annual inflation to ensure accurate and up-to-date estimations of household labor costs.

The comprehensive analysis presented in Table 4 underscores a noteworthy pattern among tobacco farmers, where an overwhelming majority derive their income primarily from agricultural pursuits. This trend persists consistently across all waves of the survey, exemplifying the centrality of agriculture as their primary source of income. In the fourth wave, 60.11 percent of current tobacco farmers diversified their income streams through business activities, while 60.66 percent also acquired earnings from wage-based employment. In sharp contrast, the analysis of former tobacco farmers reveals a tendency to engage in diverse non-agricultural activities.

Table 4. Percentage of farmers receiving income from primary sources

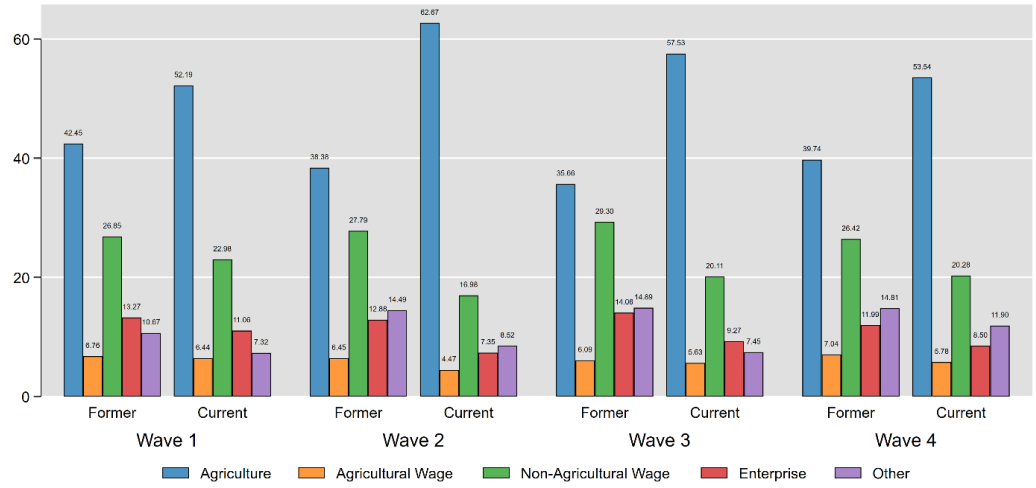
Wave	Current	Agriculture	Enterprise	Wage	Other
1[1]	former	81.18	63.53	67.45	75.67
1[1]	current	95.60	59.75	65.28	76.61
2	former	86.49	70.95	74.32	84.46
2	current	99.41	58.98	72.27	72.07
3	former	82.14	70.24	72.62	70.24
3	current	100.00	58.93	67.76	61.60
4	former	84.27	65.73	67.83	72.03
4	current	98.61	60.11	60.66	69.53

Note: [1]The sample from the first wave excludes households from West Nusa Tenggara

Figure 2 presents a comprehensive analysis of household income sources, categorized into five groups: agriculture, agricultural wages, non-agricultural wages, business, and other income. In the fourth wave, 53.54 percent of tobacco farmers primarily depend on agricultural income. Former tobacco farmers show a different trend, with a higher proportion distributed across the other four

income categories. Their diversified income sources signify a successful transition from tobacco farming, contributing to a comprehensive understanding of the financial dynamics in these distinct groups.

Figure 2. The proportion of different income sources to total HH income



Note: [1]The sample in the first wave excludes households in West Nusa Tenggara.

We calculated the average income of both current and former tobacco farmers, and the outcomes have been summarized in Table 5. Notably, the results from the fourth wave indicate that former tobacco farmers report higher income levels than tobacco farmers, except for non-tobacco agricultural profit. Specifically, the average household income for tobacco farmers is IDR 16.14 million, whereas former tobacco farmers reach an average household income of IDR 20.23 million. This trend persists across nearly all waves of our survey, with the only exception being in the second wave, where former tobacco farmers recorded higher household incomes than tobacco farmers.

Table 5. Average income from different sources, in 1,000 Indonesian rupiah

	Wave 1[1]		Wave 2		Wave 3		Wave 4	
	former	current	former	current	former	current	former	current
Non-tobacco crops profit, wet season[2]	1,663	2,142	1,311	2,967	2,271	3,536	2,561	3,020
Non-tobacco crops income, dry season[3]	-847	-639	1,070	345	4,375	1,164	2,551	872
Tobacco income[4]	-	-5,074	-	4,577	-	4,503	-	857
Enterprise income	547	570	1,159	735	571	541	1,403	1,175
Other income	1,332	813	2,648	1,759	3,648	1,899	2,723	2,585
Agricultural wage	956	1,051	1,251	1,213	2,153	1,742	2,266	1,576
Non-agricultural wage	5,789	5,004	5,927	5,336	9,285	7,120	8,559	6,926
Total HH income[5,6]	8,714	1,791	12,542	13,952	20,230	16,177	18,449	10,757

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara. [2]Non-tobacco crop profit is defined as crop sales minus inputs and costs of hired labor. [3]Non-tobacco crop income is defined as crop sales minus inputs, costs of hired labor, and household labor costs. [4]Tobacco income is defined as tobacco sales minus inputs, costs of hired labor, and household labor costs. For each wave and each group of farmers, we drop observations with total household income lower than the 5th and higher than the 95th percentiles. [5]Total household income is defined as agricultural sales plus wage income, non-farming income, and other income minus input costs, rent, costs of hired labor, and household labor costs. [6]The second, third, and fourth-wave incomes are adjusted for inflation.

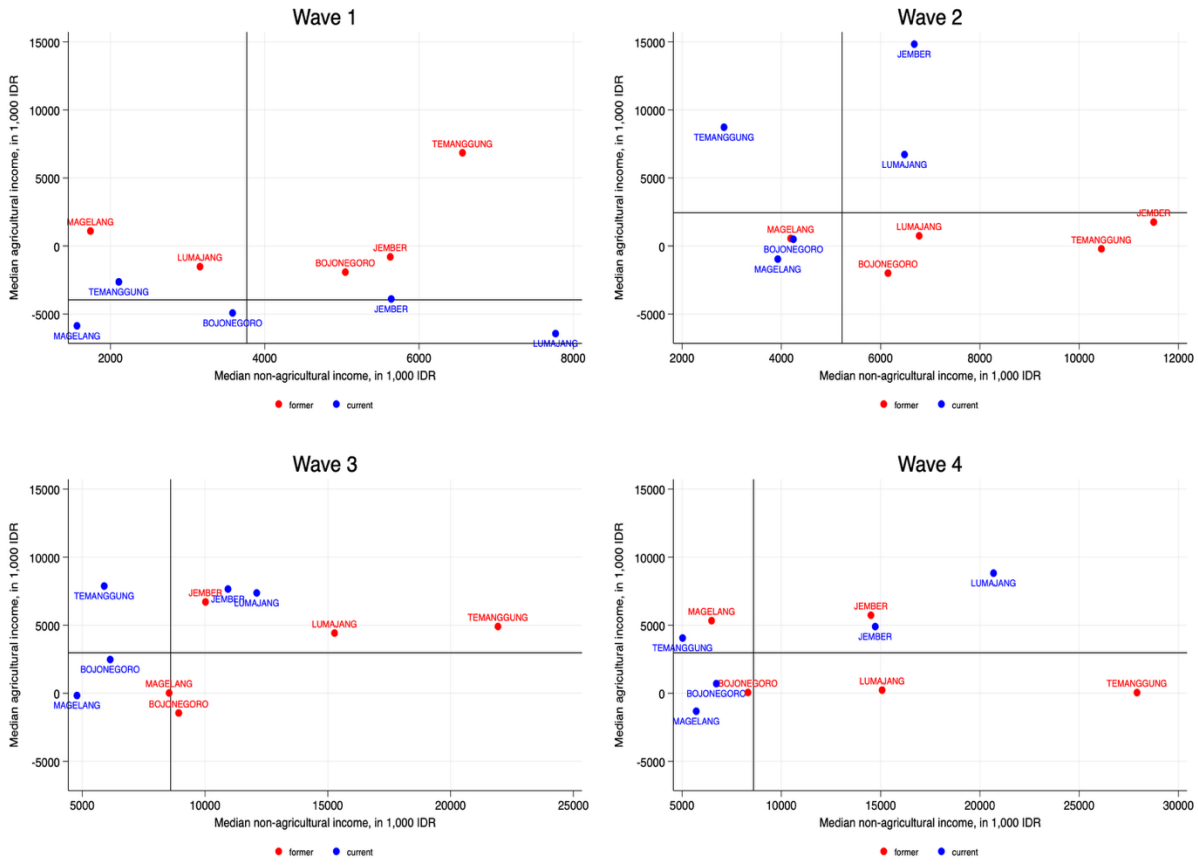
We classified income sources into two distinct categories: agricultural income, encompassing earnings from both tobacco and non-tobacco farming, and non-farm income, comprising revenues derived from enterprises, farm and non-farm wages, and other sources.

Figure 3 presents the comprehensive mapping of median farm and non-farm income across various regions. In Wave 1, a noteworthy trend emerges, where the farm income of former tobacco farmers surpasses that of tobacco farmers in all regions, despite both displaying negative income values. Moreover, agricultural income in this wave remains notably lower than in subsequent waves. Wave 2 records a significant upsurge in overall farm and non-farm income. However, during this wave, the agricultural income of non-tobacco

farmers experiences a drastic decline in Temanggung, bringing their agricultural income close to zero.

Wave 3 demonstrates relatively similar agricultural incomes for farmers and former tobacco farmers. As in Wave 2, only tobacco farmers in Jember and Lumajang report non-farm income above the median value. In Wave 4, a substantial increase in overall non-farm income is evident. Nevertheless, unlike Waves 2 and 3, only non-tobacco farmers in Jember, Temanggung, and Lumajang exhibit non-farm incomes above the median value, while non-tobacco farmers in Bojonegoro fall below the median.

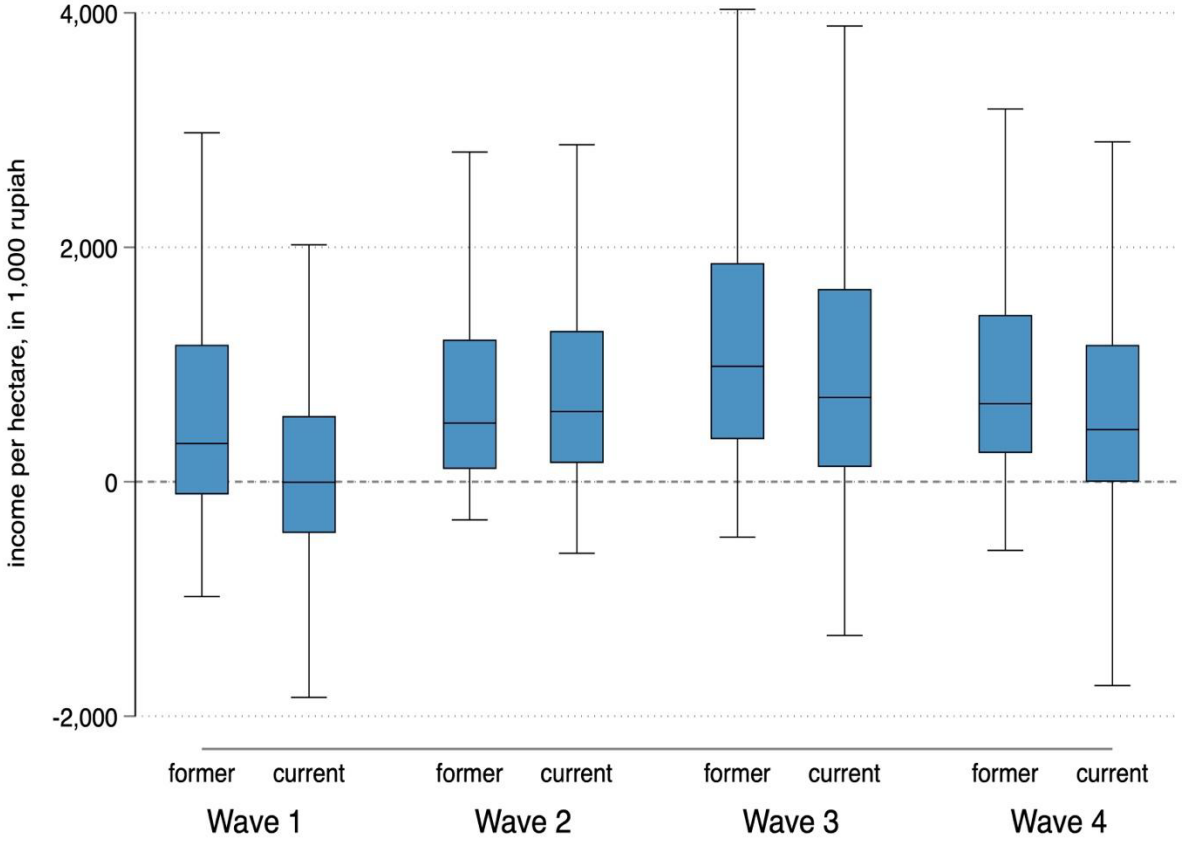
Figure 3. Median agricultural by non-agricultural income – by region



Notes: The sample in the first wave excludes households from West Nusa Tenggara.

To further investigate income distribution among farmers, we conduct analyses of both tobacco and non-tobacco farmers' incomes. The outcomes of these analyses are presented in Figure 4, showcasing the income distribution per hectare for each group of farmers across Waves 1 to 4. Our findings reveal a consistent trend of increasing incomes for both tobacco and former tobacco farmers from Wave 1 to Wave 3. However, as observed in the preceding analyses, their incomes declined in Wave 4. Notably, throughout the survey waves, the incomes of former tobacco farmers consistently surpassed those of tobacco farmers.

Figure 4. Per-capita household income



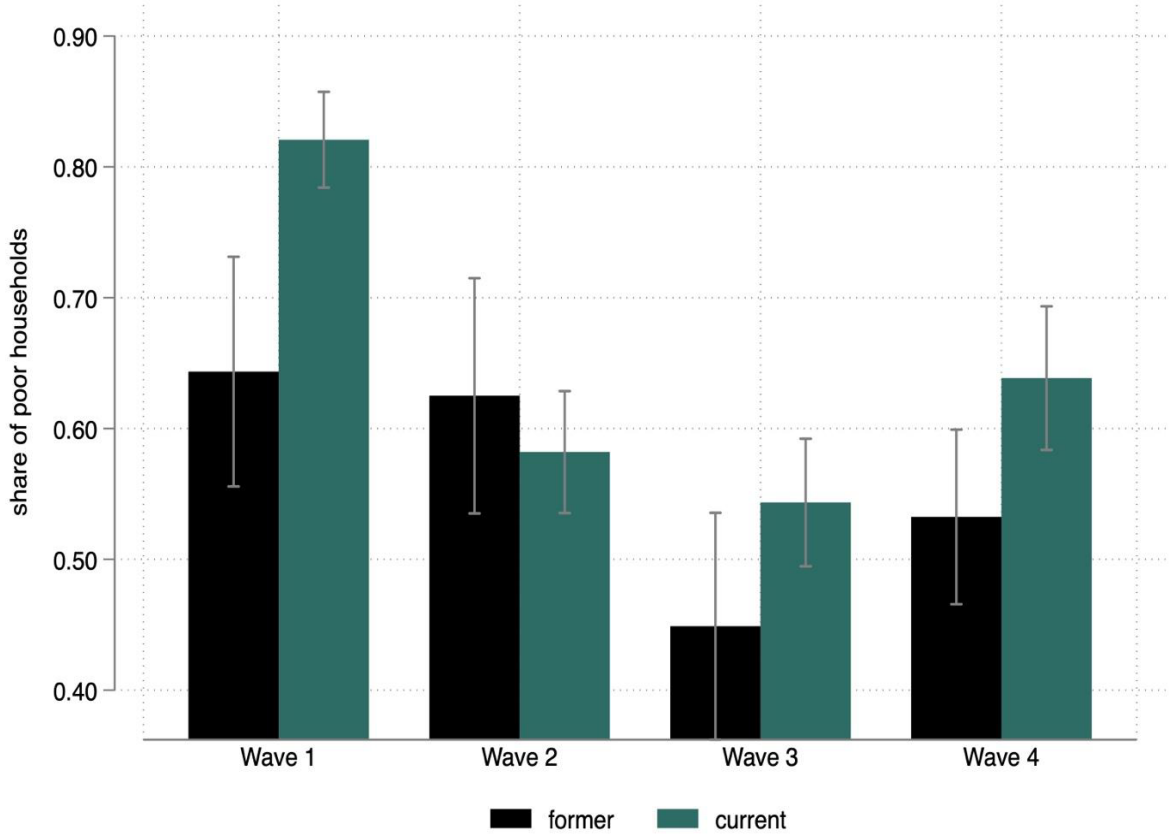
Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara. To calculate a variable's mean, we drop observations below the 5th percentile and above the 95th percentile for each group of farmers in each wave. The second, third, and fourth-wave incomes are adjusted for inflation.

3.3 Poverty

This section's analysis examines the incidence of poverty among tobacco farmers and former tobacco farmers. In Figure 5, we present a graphical representation illustrating the proportion of poor households within both groups across all four survey waves.

The findings show that the proportion of poor households tends to be higher among tobacco farmers than among former tobacco farmers. Both groups of farmers experienced the highest poverty rate in Wave 1, which could be attributed to adverse agricultural conditions. There was a notable decrease in the proportion of poor households among tobacco and former tobacco farmers in Wave 2, owing to a relatively successful farming year. In Wave 3, we observe a further decline in the share of poor farming households, particularly among former tobacco farmers. However, in Wave 4, the share of poor households increased again. These insights highlight the welfare dynamics among tobacco and former tobacco farmers within a farming year. These results also highlight the importance of continuously monitoring and addressing economic well-being among tobacco and former tobacco farming households.

Figure 5. Poverty Status of Current and Former Tobacco Farmers

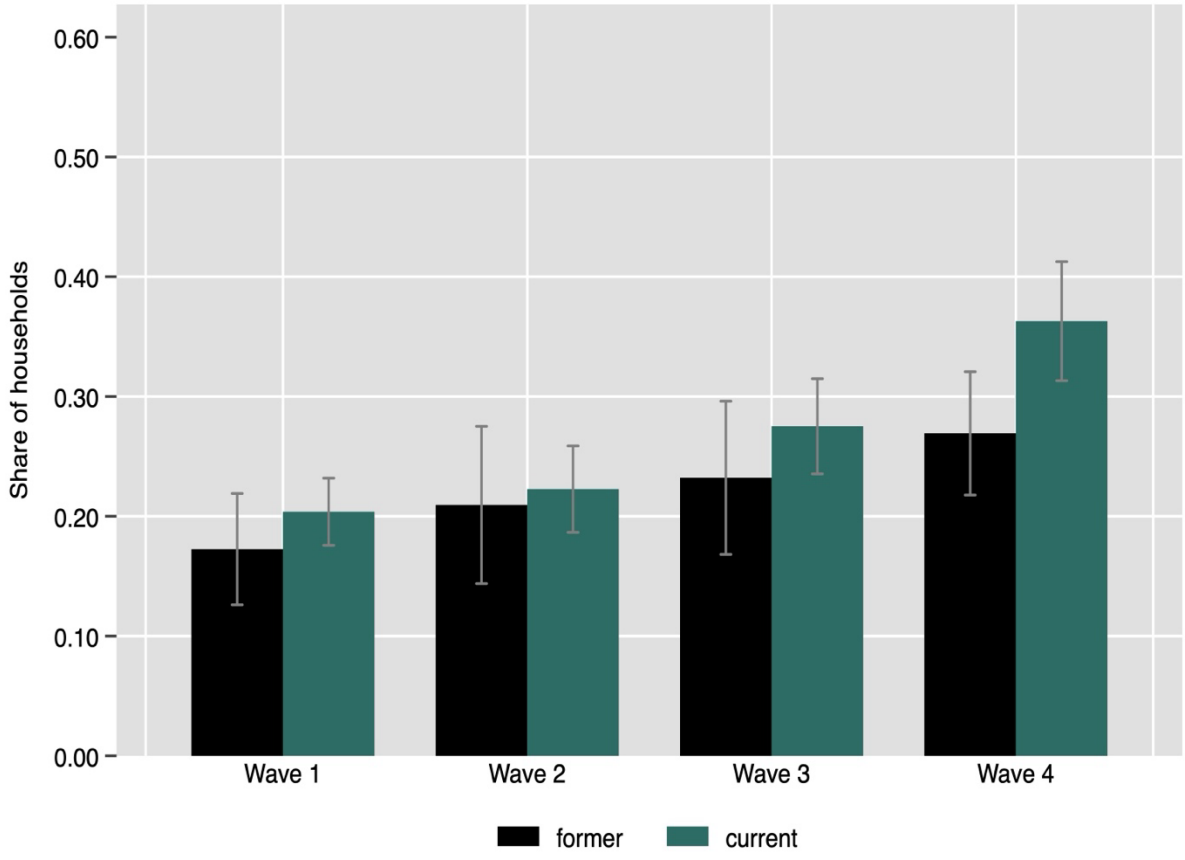


Notes: The sample in the first wave excludes households from West Nusa Tenggara.

Given the considerable share of poor farming households, we analyze farming households' utilization of social assistance programs. Figure 6 illustrates the outcomes of this examination. From a broader perspective, we observe a consistent rise in the proportion of farmer households benefitting from social assistance programs across all survey waves. This positive trend extends particularly among tobacco farmers. Notably, the proportion of tobacco farmers participating in social assistance programs exceeds that of former tobacco farmers. In Wave 4, we identified a substantial surge in the utilization of social assistance programs among tobacco farmers. The increase in participation in

social assistance programs can be partially explained by the program's expansion that year.

Figure 6. Participation in Social Security Card (KPS) or Family Welfare Card (KKS)



Note: The sample in the first wave excludes households from West Nusa Tenggara.

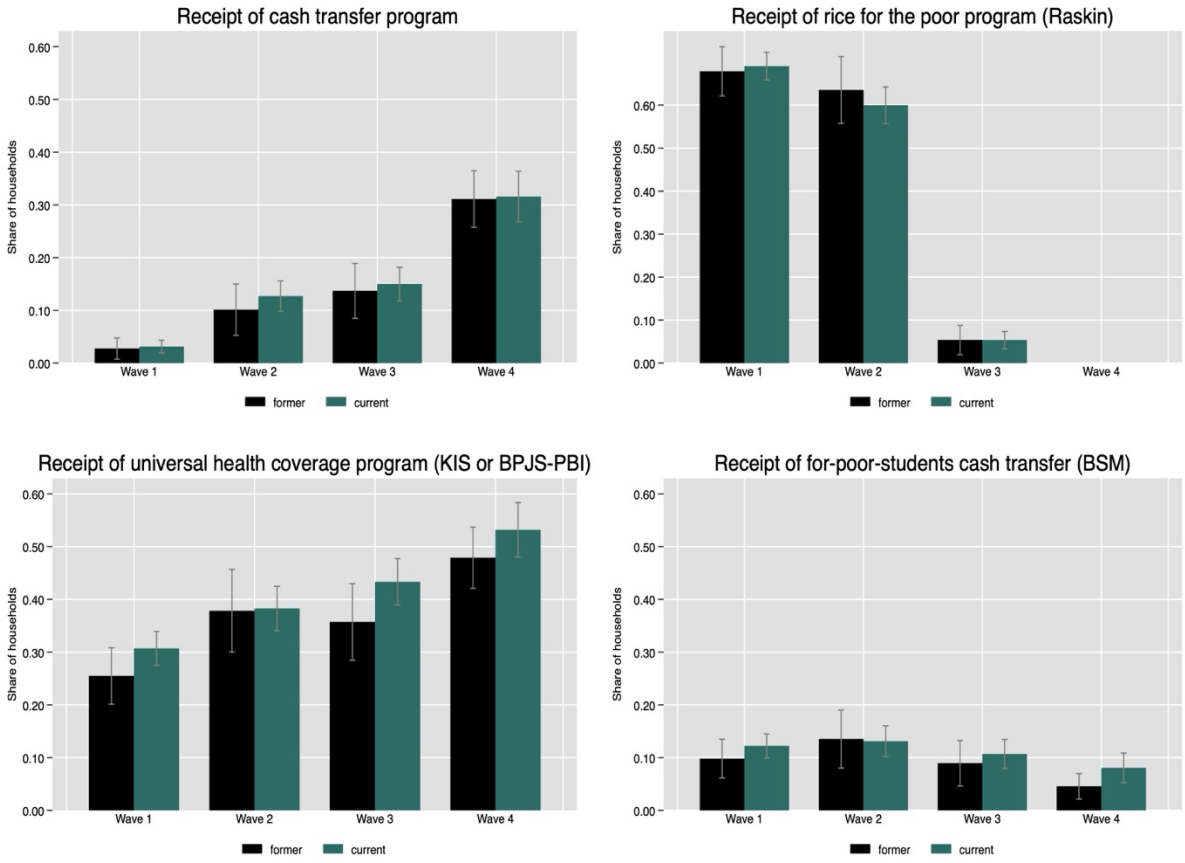
We delve further into farmers' receipts of different social assistance programs. The government has implemented various social programs in Indonesia to support underprivileged households, including health insurance, education cash transfers, direct cash transfers, food assistance, and other initiatives. Figure 7 presents a statistical analysis of farming households benefiting from different forms of social assistance, namely cash transfers, the rice program for

poor households (Raskin), KIS or BPJS-PBI health insurance, and BSM/KIP education assistance.

Our analysis reveals a consistent increase in the share of transfer recipients across all survey waves, particularly among tobacco farmers. The number of recipients of the Rice for Poor Households (Raskin) program declined after Wave 2. This finding can be attributed to the transition from the Raskin program into electronic voucher programs (*Bantuan Pangan Non-Tunai*).

Meanwhile, farming households that are recipients of KIS or BPJS-PBI health insurance have been increasing yearly, both for tobacco and former tobacco farmers. However, the share of recipients of this assistance was more prevalent among tobacco farmers. The share of BSM education assistance recipients increased in Wave 2, but decreased in subsequent waves. In Wave 4, the share of tobacco farmers who received BSM education assistance was about twice as many as former tobacco farmers.

Figure 7. Current and former tobacco farmers receive various government social programs.



Note: The sample in the first wave excludes households from West Nusa Tenggara.

3.4 Land Use

Our survey investigates land use, particularly land ownership and cultivation over the past 12 months, as presented in Table 6. It is important to note that cultivated land encompasses areas utilized for farming, comprising lands designated for tobacco and other crop cultivation.

Our data show that the lowest cultivated land is found in Wave 1 for both tobacco and non-tobacco farmers. The survey results also show that the size of agricultural land owned and cultivated by farmers in East Java is larger than that in Central Java. Tobacco farmers' farmland tends to be larger than non-

tobacco farmers. Our data show that the area devoted to tobacco farming is only a tiny portion of the total cultivated land in all survey waves, especially in the Bojonegoro and Magelang regions. The land area devoted to tobacco farming is the lowest in the Magelang region, and this finding is consistent across all survey waves. In Wave 4, we discern a decline in the land area owned by tobacco farmers, like the trend observed among non-tobacco farmers.

Table 6. Median total land owned (hectares), under cultivation and tobacco cultivation by region, current and former tobacco farmers

	Current			**Former**	
Wave 1	**Tobacco**	**Cultivated**	**Owned**	**Cultivated**	**Owned**
Bojonegoro	0.16	0.60	0.25	0.52	0.25
Jember	0.20	0.53	0.13	0.18	0.19
Lumajang	0.23	0.54	0.19	0.60	0.20
Magelang	0.06	0.20	0.10	0.08	0.05
Temanggung	0.35	0.78	0.30	0.01	0.18
Wave 2	**Tobacco**	**Cultivated**	**Owned**	**Cultivated**	**Owned**
Bojonegoro	0.28	1.21	0.40	0.98	0.30
Jember	0.30	1.05	0.25	0.12	0.11
Lumajang	0.17	0.48	0.11	0.50	0.25
Magelang	0.13	0.38	0.18	0.34	0.18
Temanggung	0.25	0.63	0.39	0.14	0.19
Wave 3	**Tobacco**	**Cultivated**	**Owned**	**Cultivated**	**Owned**
Bojonegoro	0.25	1.06	0.29	0.70	0.28
Jember	0.4	1.17	0.35	0.90	0.46
Lumajang	0.34	1.53	0.42	1.25	0.5
Magelang	0.2	0.51	0.35	0.11	0.16
Temanggung	0.36	0.84	0.49	0.08	0.1
Wave 4	**Tobacco**	**Cultivated**	**Owned**	**Cultivated**	**Owned**
Bojonegoro	0.25	0.95	0.25	0.85	0.38
Jember	0.25	0.79	0.25	0.70	0.25
Lumajang	0.25	1.73	0.43	1.00	0.42
Magelang	0.12	0.43	0.20	0.24	0.12
Temanggung	0.36	0.81	0.38	0.05	0.13

Note: The sample in the first wave excludes households from West Nusa Tenggara.

We conducted a thorough data collection process regarding the legal land rights possessed by farmers. The outcomes of our comprehensive analysis are presented in Table 7 and classified by individual land parcels. Our findings reveal that the highest number of land parcels was recorded during the first wave of the survey. Subsequently, a noteworthy trend is observed, wherein the proportion of land owned by tobacco farmers exhibited a progressive increase from Wave 1 to Wave 3. However, in Wave 4, a marginal decline is observed in the proportion of land ownership by tobacco farmers. Concurrently, it is evident that non-tobacco farmers experienced an increase in land ownership in Wave 4 following a decrease in Wave 2.

Table 7. Legal entitlement of land – current and former tobacco farmers, by parcel and in percentage of total

Ownership	**Wave 1**			**Wave 2**		
	Current	**Former**	**Total**	**Current**	**Former**	**Total**
Granted by local leader	0.65	0.60	0.64	0.36	0.99	0.47
Owned	65.04	73.56	66.75	71.23	68.98	70.83
Rented	22.26	15.51	20.91	18.79	18.48	18.74
Tenant (no rent)	11.30	9.94	11.03	3.08	5.61	3.54
Other	0.75	0.40	0.68	6.53	5.94	6.42
Total	2,008	503	2,511	1,394	303	1,697
Ownership	**Wave 3**			**Wave 4**		
	Current	**Former**	**Total**	**Current**	**Former**	**Total**
Granted by local leader	1.10	.	0.91	1.16	0.52	0.92
Owned	72.63	77.44	73.68	71.53	79.55	74.56
Rented	24.58	19.30	23.37	22.96	16.08	20.37
Tenant (no rent)	0.95	3.26	1.47	4.34	3.85	4.15
Other	0.73	.	0.57	.	.	.
Total	1,363	399	1,763	572	945	1,517

Note: The sample in the first wave excludes households from West Nusa Tenggara.

4 The Economics of Tobacco Growing

4.1 Characteristics of tobacco farming: contracts, production, and prices

In our comprehensive TFS survey questionnaire, we extensively covered inquiries regarding the various types of tobacco cultivated in all target regions. As evidenced in Table 8, noteworthy diversity exists in the types of tobacco grown, with Virginia being the most prominently cultivated variety across all examined regions. Conversely, the Oriental variety exhibited the least prevalence in cultivation. The dynamic changed significantly in Wave 4 as most farmers were planting local types of tobacco instead of planting the Virginia type.

Table 8. Type of tobacco farming enterprise by region

District	Wave 1				Wave 2			
	Virginia	Burley	Oriental	Other	Virginia	Burley	Oriental	Other
Bojonegoro	316	0	72	.	431	0	34	36
Jember	483	18	1	.	557	27	2	8
Lumajang	62	96	0	.	35	91	0	62
Magelang	154	0	0	.	11	0	8	163
Temanggung	313	0	0	.	183	0	4	86
Total	1,326	114	73	.	1,217	118	48	355
District	**Wave 3**				**Wave 4**			
	Virginia	**Burley**	**Oriental**	**Other**	**Virginia**	**Burley**	**Oriental**	**Other**
Bojonegoro	449	147	12	0	37	0	6	309
Jember	219	165	71	143	38	0	4	282
Lumajang	123	53	5	3	4	10	4	45
Magelang	210	55	4	0	21	7	35	138
Temanggung	83	85	47	0	0	0	4	249
Total	1,084	505	139	146	100	17	53	1,023

Notes: The sample in the first wave excludes households from West Nusa Tenggara

In the subsequent phase of our analysis, we examined the distribution of contract and independent tobacco farmers. This analytical approach explains potential regional disparities or imbalances in the prevalence of contracted and independent farming arrangements. Based on the insights gleaned and shown in Table 9, it is evident that most tobacco farmers were operating as independent entities, not bound by contractual agreements. This pattern remains consistent across all regions. Furthermore, our findings reveal a diminishing number of contract farmers over the waves of the survey. In East Java, the count of contract farmers surpassed that of Central Java, although a noteworthy presence of independent farmers is also observed in Bojonegoro and Jember.

An overall decline in the number of contract and independent farmers is evident as well. Notably, the number of contract farmers reduced to only 13 in East Java and 10 in Central Java by Wave 4. However, it is imperative to consider that this decline may be influenced by a decrease in the sample size for the corresponding question. Jember registers the highest number of independent farmers, totaling 91 individuals, whereas Lumajang reports the lowest count, with only 22 independent farmers. These findings provide valuable insights into the evolving dynamics of contract and independent tobacco farming practices in different regions, significantly enhancing our comprehension of the agricultural landscape in this context.

Table 9. Distribution of contract and independent tobacco farmers by region

District	Wave 1					Wave 2				
	Contract	%	Ind.	%	Total	Contract	%	Ind.	%	Total
Bojonegoro	51	36.69	189	28.81	240	26	30.95	107	25.00	133
Jember	31	22.30	209	31.86	240	20	23.81	118	27.57	138
Lumajang	49	35.25	26	3.96	75	31	36.90	52	12.15	83
Magelang	1	0.72	119	18.14	120	1	1.19	79	18.46	80

Temanggung	7	5.04	113	17.23	120	6	7.14	72	16.82	78
Total	139	100	656	100	795	84	100	428	100	512
	Wave 3					**Wave 4**				
	Contract	**%**	**Ind.**	**%**	**Total**	**Contract**	**%**	**Ind.**	**%**	**Total**
Bojonegoro	24	33.33	114	27.47	138	4	12.12	79	24.08	83
Jember	13	18.05	128	30.84	141	9	27.27	91	27.74	100
Lumajang	28	38.89	30	7.23	58	10	30.30	22	6.71	32
Magelang	0	0	72	17.35	72	3	9.09	65	19.82	68
Temanggung	7	9.72	71	17.11	78	7	21.21	71	21.65	78
Total	72	100	415	100	487	33	100	328	100	361

Note: The sample in the first wave excludes households from West Nusa Tenggara.

Our rigorous analysis of tobacco sales volume, prices, and revenue has provided us with a comprehensive understanding of the performance and dynamics of the tobacco market throughout the survey period. A summary of our findings is presented in Table 10. During Wave 1 to Wave 3, we observed a general increase in the quantity of tobacco leaves sold in most regions under examination, except Temanggung. However, within this trend, we found a decline in the amount of tobacco sold in the East Java regions, contributing to an overall decrease in the median amount of tobacco leaves sold from 506 kilograms to 400 kilograms in Wave 4.

Moreover, the movement of tobacco prices in the East Java region exhibited a notable upsurge, except for the Jember region, which recorded a slight decrease in tobacco prices. Conversely, tobacco prices in the Central Java region experienced a decline compared to the previous wave. Our analysis also revealed

a significant increase in sales revenue in the Magelang region despite a decrease in the price per kilogram of tobacco from the preceding wave. A similar significant increase in sales revenue was observed in the Lumajang region. Nonetheless, it is essential to acknowledge that the overall median sales revenue across all areas decreased from IDR 1.61 million in Wave 3 to IDR 1.42 million in Wave 4.

Table 10. Median tobacco volume of leaf sold, prices, and sales by region

Region	Volume sold (kg)				Price per kg (IDR)				Sales (1,000 IDR)			
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 1	Wave 2	Wave 3	Wave 4	Wave 1	Wave 2	Wave 3	Wave 4
Bojonegoro	179	455	650	570	6,000	6,730	5,466	14,155	400	673	797	755
Jember	200	550	600	400	15,000	31,730	22,779	22,118	1,535	4,183	3,173	3,124
Lumajang	240	298	478	260	25,000	28,846	30,979	35,388	2,337	4,038	2,733	5,175
Magelang	290	340	393	438	3,000	4,615	4,555	2,654	700	600	683	4,379
Temanggung	270	280	240	355	35,000	67,307	72,892	39,812	1,590	2,826	4,592	2,884
Total	204	400	506	400	20,000	24,038	18,223	19,021	1,075	1,923	1,610	1,415

Note: The sample in the first wave excludes households from West Nusa Tenggara. The prices and sales in the last three waves are adjusted for inflation.

To comprehensively analyze tobacco sales data, we have delved into the data categorized by variety and compiled our findings in Table 11. As evident in the preceding table, there is a discernible decrease in the median amount of tobacco sold during Wave 4. Notably, the Virginia variety dominated this wave, exhibiting a substantial increase of 45 percent from the previous wave. In contrast, Burley emerged as the tobacco variety with the lowest median volume sold, standing at 325 kilograms. This observation aligns with the data presented in Table 8, which reveals the relatively limited cultivation of Burley tobacco in Wave 4.

A significant disparity in the median price of Burley is evident, with this variety reaching the highest level among all other tobacco varieties, amounting to IDR28,754. This represents a notable increase of approximately 66 percent from the previous wave. Interestingly, this increase in Burley prices has significantly compensated for the notable decline observed in the median price of Oriental tobacco varieties. Despite this notable decrease in Oriental prices, the median tobacco price increased from the previous wave. The surge in Burley prices has contributed to the highest median sales increase compared to other tobacco varieties even with the decrease in the amount of Burley sold. These valuable insights enhance our understanding of the varietal brand dynamics and their impact on the overall tobacco market performance during the study period.

Table 11. Median volume of tobacco leaf sold, price, and income by leaf type

Type	Volume sold (kg)				Price per kg (IDR)				Sales (1,000 IDR)			
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 1	Wave 2	Wave 3	Wave 4	Wave 1	Wave 2	Wave 3	Wave 4
Virginia	233	499	500	725	16,000	24,038	15,490	17,695	1,000	1,923	1,212	1,974
Burley	210	695	450	325	25,000	25,000	17,312	28,754	1,807	5,488	1,739	2,962
Oriental	120	260	580	572	25,000	25,961	36,447	35,390	2,000	4,230	4,337	444
Total	200	400	500	400	20,000	24,038	18,223	19,022	1,075	1,923	1,611	1,579

Note: The sample in the first wave excludes households from West Nusa Tenggara. The prices and sales in the last three waves are adjusted for inflation.

We also investigated median tobacco prices, specifically by grade (i.e., quality) and leaf type, to study the market dynamics. The results of this analysis are presented in Table 12. Based on the analysis, a decrease in the median price of Virginia tobacco was observed, along with a reduction in grade in Waves 1, 2, and 3. However, in Wave 4, there was a change in the price dynamics for Virginia grades, where the price for the B grade was found to be lower than the C grade. In addition, we noted a highly significant decrease of more than 75 percent in the median price for class D of Virginia tobacco.

Meanwhile, the median price of Burley tobacco showed a sharp increase for all its grades in wave 4, especially for grade D, which reached a rise of more than 190 percent. In contrast, the price of Oriental tobacco experienced a very significant decline in wave 4. Among all classes, only class D showed the most negligible decline in median price for Oriental tobacco.

Table 12. Median tobacco price by grade and leaf type, in IDR

Grade	Virginia				Burley				Oriental			
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 1	Wave 2	Wave 3	Wave 4	Wave 1	Wave 2	Wave 3	Wave 4
A	18,000	25,961	18,223	19,906	32,500	27,884	15,489	34,504	23,000	28,846	46,697	4,865
B	15,000	22,115	18,223	15,924	25,000	29,615	18,223	28,311	28,000	36,057	41,002	2,875
C	10,000	19,230	13,667	17,694	20,500	20,192	14,578	26,762	23,000	25,961	36,446	2,654
D	20,000	28,846	9,567	8,847	18,000	-	13,667	39,812	27,000	40,865	14,578	14,022
Total	16,000	24,038	15,489	17,694	25,000	25,000	17,312	28,753	25,000	25,961	36,446	3,538

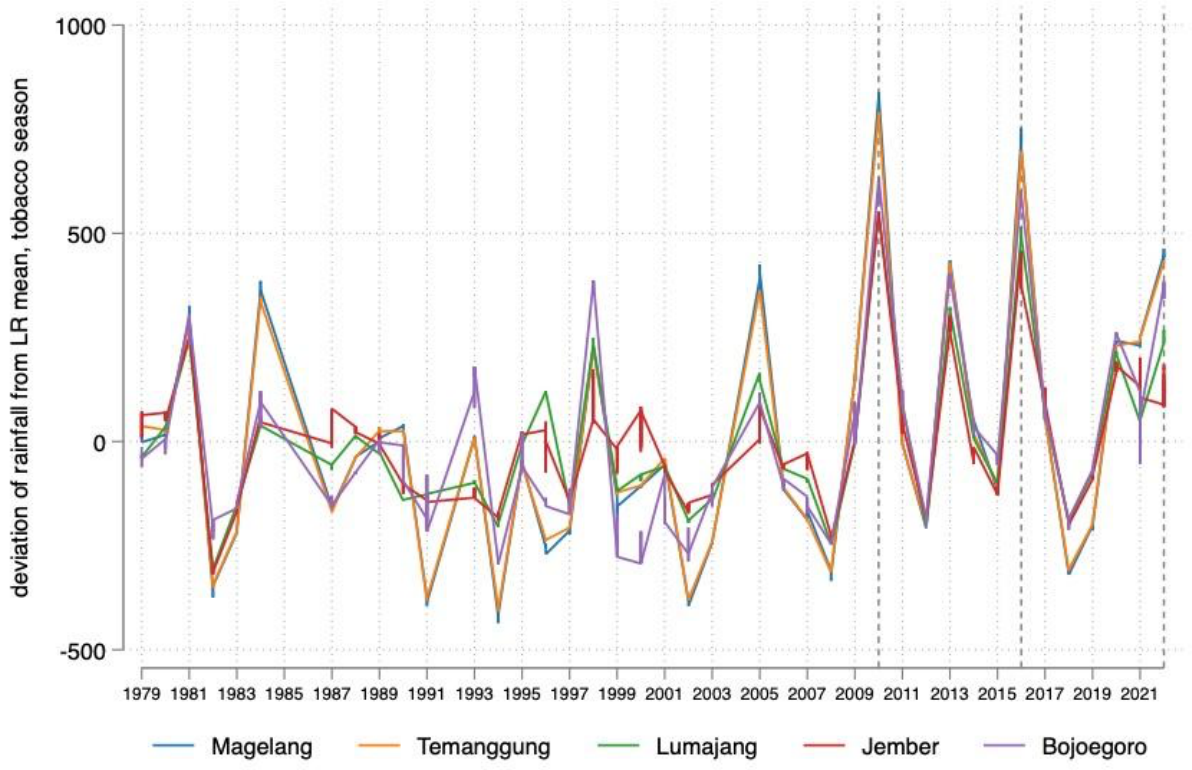
Note: The sample in the first wave excludes households from West Nusa Tenggara. The prices and sales in the second and third wave are adjusted for inflation.

The thorough analysis of the collected data reveals substantial variations in tobacco production and prices across different waves. One potential explanatory factor for this variation is weather conditions, with dry weather being highlighted as crucial for determining tobacco harvest, as emphasized by Syahid Muttaqin et al. (2019). To investigate the influence of weather, we utilized rainfall as a proxy and depicted the historical rainfall patterns from 1979 to 2021 in the five surveyed regions in Figure 8.

Our examination of rainfall data highlights a significant difference between the survey's first and subsequent waves. This discrepancy potentially accounts for lower tobacco production and prices in the later waves. Waves 2 and 3 experienced rainfall close to their long-term averages, whereas Wave 4 saw increased rainfall, substantially deviating from the long-term average. This deviation could contribute to the decline in tobacco sales during that period.

Analyzing the regions, we note that Temanggung and Magelang encountered the most significant rainfall deviation in Wave 4. This circumstance could have affected the decline in tobacco prices in these regions during the corresponding survey year. In contrast, Jember, with the lowest rainfall deviation, experienced a decrease in the amount of tobacco sold and prices, possibly influenced by market factors not captured by our survey, necessitating additional consideration in a broader context.

Figure 8. Deviation of rainfall from the long-term average (in mm), 1979-2022



Moreover, we analyzed the types of tobacco buyers by region, shedding light on distinct patterns among various buyer groups in each surveyed area, as presented in Table 13. Individual intermediaries/collectors emerged as the predominant buyers across all regions, except for Lumajang, where company collectors dominated in waves 1 and 2 and cigarette company warehouses in wave 3. Despite declining tobacco production and sales in wave 4, individual intermediaries retained their majority share among tobacco buyers. Additionally, while the number of buyers from company collectors and cigarette company warehouses decreased, purchases by other farmers remained relatively stable, even slightly increasing in some regions. These findings contribute to a more comprehensive understanding of the dynamics of tobacco markets and consumption patterns in the study areas.

Table 13. Type of tobacco leaf buyers by region

Wave 1	Individual middlemen/ collector	Other farmers	Contract representative	Company collector	Cigarette company warehouse	Cigarette company	Other	Total
Bojonegoro	309	13	5	25	36	-	-	388
Jember	389	15	1	30	58	7	2	502
Lumajang	10	2	17	76	39	14	-	158
Magelang	118	11	-	3	21	1	-	154
Temanggung	217	21	17	5	32	21	-	313
Wave 2	**Individual middlemen/ collector**	**Other farmers**	**Contract representative**	**Company collector**	**Cigarette company warehouse**	**Cigarette company**	**Other**	**Total**
Bojonegoro	399	43	-	3	53	2	1	501
Jember	479	14	27	15	59	-	-	594
Lumajang	45	19	3	113	-	2	6	188
Magelang	154	23	-	-	3	-	2	182
Temanggung	234	13	4	10	6	6	-	273
Wave 3	**Individual middlemen/ collector**	**Other farmers**	**Contract representative**	**Company collector**	**Cigarette company warehouse**	**Cigarette company**	**Other**	**Total**
Bojonegoro	529	13	-	22	44	-	-	608
Jember	478	12	3	30	75	-	-	598
Lumajang	31	15	-	31	102	-	5	184
Magelang	231	19	-	10	5	4	-	269
Temanggung	162	15	-	17	20	-	-	214

Wave 4	Individual middlemen/ collector	Other farmers	Contract representative	Company collector	Cigarette company warehouse	Cigarette company	Other	Total
Bojonegoro	324	22	-	5	-	-	-	352
Jember	240	16	4	36	23	5	-	324
Lumajang	22	10	27	-	4	-	-	63
Magelang	167	11	4	9	7	-	3	201
Temanggung	196	18	8	7	13	7	4	253

Note: The sample in the first wave excludes households from West Nusa Tenggara.

4.2 Costs of tobacco farming

This section delves into a critical aspect of tobacco farming: the costs incurred in the production process. Our primary focus is to analyze both the farming and labor costs, which are pivotal factors influencing the success and efficiency of tobacco farming.

Table 14 presents an analysis of the utilization of input products in tobacco farming and their average prices. Our analysis reveals a consistent trend in overall input usage throughout the survey waves. Tobacco farmers' significant increase in transportation usage from Wave 1 to subsequent waves is particularly noteworthy. This surge may be attributed to higher tobacco sales during the survey periods.

Furthermore, we observed a remarkable decrease in the proportion of oil usage in Wave 3, plummeting from 15.23 percent to 4.52 percent. This decline coincided with a 61 percent increase in the average cost of oil, possibly indicative of a price hike. Nonetheless, it is crucial to acknowledge that other market-related factors may have also contributed to the reduction in oil usage. In addition to oil, the average cost of pesticides increased in Wave 3, and this trend continued in Wave 4.

In Wave 4, the proportion of input usage displayed minimal changes compared to the previous wave. However, a notable difference was observed in the utilization of equipment or livestock rentals. Specifically, the proportion of tobacco farmers availing of this resource decreased from 51.54 percent in Wave 3 to 31.86 percent in Wave 4. This development may affect the efficiency and productivity of tobacco farming. Average input costs did not change significantly from previous waves, indicating the stability of input costs during the survey period. These findings contribute crucial insights into the cost dynamics of

tobacco farming, serving as valuable information for evaluating the economic aspects of this agricultural endeavor.

Table 14. Main inputs for tobacco farming and average cost (current dry season)

Input	Wave 1		Wave 2		Wave 3		Wave 4	
	Proportion of farmers who used the item (%)	Average costs (1,000 IDR)	Proportion of farmers who used the item (%)	Average costs (USD PPP)	Proportion of farmers who used the item (%)	Average costs (USD PPP)	Proportion of farmers who used the item (%)	Average costs (USD PPP)
Fertilizer non-organic	97.99	1,000	97.85	1,009	99.59	1,129	98.89	1,041
Fertilizer	45.91	1,408	49.22	1,209	46.41	1,256	55.40	1,104
Pesticides (chemicals)	80.00	274	90.04	218	92.20	321	91.14	382
Gasoline for tobacco farming equipment	38.49	307	22.85	337	27.10	565	21.33	521
Oil	13.58	256	15.23	61	4.52	98	8.59	75
Firewood/fuel wood	4.65	556	8.59	930	7.80	736	6.65	897
Bamboo, bamboo sticks, rice hay, descuke-ride	46.79	-	54.10	-	46.61	-	47.09	-
Knapsack Sprayer	82.01	-	92.38	-	90.55	-	94.18	-
Drums	22.77	-	30.66	-	27.52	-	33.80	-
Sprinkler	68.30	-	78.91	-	79.26	57	75.07	50
Rental of equipment/livestock	37.74	609	43.95	546	51.54	583	31.86	525
Transportation (to market)	47.67	-	78.52	222	84.80	419	74.24	328
Water pump	22.01	-	25.78	-	31.21	-	29.92	-
Mattock, sickle	99.62	-	99.41	-	99.38	-	98.06	-
Others	10.44	682	12.30	1,208	45.59	1,008	29.64	1,130

Note: The sample in the first wave excludes households from West Nusa Tenggara. The costs in the last three waves of the survey are adjusted for inflation.

Table 15 reports data on the use of agricultural inputs by tobacco farmers in cultivating crops other than tobacco, including in the dry and wet seasons. We also summarize the average cost incurred by farmers for each input. The Wave 4 statistics show a difference in the pattern of costs and input usage among tobacco farmers between the dry and wet seasons. However, these differences have also been observed in the previous survey waves, suggesting a consistency in farmers' behavior regarding input usage across seasons.

Our analysis revealed a significant increase in the use of oil by farmers in Wave 4, and this phenomenon is likely related to the decrease in the average cost of oil seen in this wave compared to Wave 3. This result indicates a change in farmers' preference for specific inputs and their adaptation to market dynamics and potential price changes. In addition, we observe an increase in the cost of non-organic fertilizers by more than 35 percent in the dry season in Wave 4 compared to the dry season in Wave 3. Despite the rise in cost, the use of non-organic fertilizers tends to show stability, indicating a possible increase in the price of this type of fertilizer and the importance of using this type of fertilizer in their farming practices.

Table 15. Tobacco farmers' inputs for cultivating non-tobacco crops

Wave 1	**Dry season**		**Wet season**	
	Proportion of farmers who used the item (%)	**Average costs (1,000 IDR)**	**Proportion of farmers who used the item (%)**	**Average costs (1,000 IDR)**
Fertilizer non-organic	84.94	435	98.13	876
Fertilizer	41.87	276	61.28	643
Pesticides (chemicals)	60.54	216	83.44	392
Gasoline for tobacco farming equipment	31.02	160	35.65	326
Oil	8.13	45	10.15	78
Firewood/fuel wood	0.30	5	0.80	147
Bamboo, bamboo sticks, rice hay, descuke-ride	11.45	.	15.35	.

Knapsack Sprayer	63.55	.	85.71	.
Drums	19.28	.	14.55	.
Sprinkler	52.71	.	26.57	.
Rental of equipment/livestock	31.93	384	50.87	541
Transportation (to market)	32.83	.	40.99	.
Water pump	21.99	.	16.96	.
Mattock, sickle	97.29	.	99.47	.
Others	3.92	719	6.68	996
Wave 2	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**
Fertilizer non-organic	89.78	534	96.52	1,428
Fertilizer	50.00	406	56.15	722
Pesticides (chemicals)	71.53	197	89.34	324
Gasoline for tobacco farming equipment	14.96	173	12.09	151
Oil	8,76	42	4.51	51
Firewood/fuel wood	0.00	.	0.41	144
Bamboo, bamboo sticks, rice hay, descuke-ride	16.42	.	20.70	.
Knapsack Sprayer	74.82	.	90.57	.
Drums	21.17	.	13.32	.
Sprinkler	56.93	.	31.56	.
Rental of equipment/livestock	36.50	382	50.41	660
Transportation (to market)	68.25	122	72.75	151
Water pump	22.99	.	14.55	.
Mattock, sickle	95.99	.	98.57	.
Others	8.76	305	10.04	547
Wave 3	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**
Fertilizer non-organic	87.45	565	98.02	1,105
Fertilizer	47.70	365	52.53	794
Pesticides (chemicals)	72.80	330	90.33	350

Gasoline for tobacco farming equipment	21.34	360	18.24	197
Oil	1.67	52	0.88	101
Firewood/fuel wood	0.00	.	0.44	50
Bamboo, bamboo sticks, rice hay, descuke-ride	17.99	.	18.46	.
Knapsack Sprayer	73.22	.	91.65	.
Drums	23.85	.	14.51	.
Sprinkler	58.16	.	29.23	.
Rental of equipment/livestock	41.00	275	59.78	708
Transportation (to market)	74.06	173	86.15	242
Water pump	23.01	.	21.32	.
Mattock, sickle	93.31	.	99.12	.
Others	27.62	588	33.63	720
Wave 4	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**
Fertilizer non-organic	87.14	877	96.65	991
Fertilizer	53.57	377	57.01	736
Pesticides (chemicals)	75.00	265	88.41	427
Gasoline for tobacco farming equipment	12.14	204	9.15	155
Oil	4.29	28	2.44	67
Firewood/fuel wood	0.00	.	0.30	133
Bamboo, bamboo sticks, rice hay, descuke-ride	15.00	.	23.78	.
Knapsack Sprayer	72.86	.	89.94	.
Drums	27.14	.	18.29	.
Sprinkler	54.29	.	31.40	.
Rental of equipment/livestock	29.29	495	44.82	715
Transportation (to market)	61.43	148	73.48	257
Water pump	17.86	.	14.02	.
Mattock, sickle	96.43	.	96.65	.
Others	11.43	39	10.67	171

Note: The sample in the first wave excludes households from West Nusa Tenggara. The costs in the last three waves of the survey are adjusted for inflation.

In addition to collecting data from tobacco farmers, we gathered corresponding information from former tobacco farmers to facilitate comparative analyses.

Table 16 presents a concise overview of the statistical data encompassing the utilization of farm production inputs by non-tobacco farmers, alongside the average costs of these inputs. Notably, discernible differences in farm production input usage patterns emerge when comparing tobacco farmers to their non-tobacco farming counterparts. Compared to tobacco farmers, non-tobacco farmers exhibited a decline in the average cost of inorganic fertilizers from Wave 3. This observation indicates a potential cost-saving strategy employed by non-tobacco farmers in the utilization of inorganic fertilizers, which could have implications for their farming efficiency and overall productivity.

Furthermore, our analysis also revealed a notable decrease of approximately 37 percent in the average cost of gasoline during the dry season between Wave 3 and Wave 4. The proportion of gasoline users remained relatively constant despite declining gasoline costs. This suggests that farmers have consistently maintained usage levels comparable to those of the previous survey wave, signifying a stable preference and necessity for gasoline in their farming activities. On a different note, in Wave 4, we observed a complete absence of farmers utilizing firewood as a production input. This finding suggests that using firewood as a fuel source in agriculture is not a predominant choice among tobacco and non-tobacco farmers. Such a choice is good for the local environment, but farmers can be vulnerable to future fossil fuels price increase as a result.

Table 16. Former tobacco farmers' main inputs for cultivating non-tobacco crops

Wave 1	Dry season		Wet season	
	Proportion of farmers who used the item (%)	Average costs (1,000 IDR)	Proportion of farmers who used the item (%)	Average costs (1,000 IDR)
Fertilizer non-organic	91.79	915	97.07	930
Fertilizer	53.62	1,120	54.63	705
Pesticides (chemicals)	71.98	635	83.90	411
Gasoline for tobacco farming equipment	42.51	227	41.46	220
Oil	14.01	62	18.05	70
Firewood/fuel wood	0.48	100	.	.
Bamboo, bamboo sticks, rice hay, descuke-ride	16.43	.	11.22	.
Knapsack Sprayer	76.81	.	87.32	.
Drums	16.43	.	15.61	.
Sprinkler	48.31	.	32.20	.
Rental of equipment/livestock	45.41	525	69.27	619
Transportation (to market)	51.21	.	51.71	.
Water pump	14.98	.	19.02	.
Mattock, sickle	98.55	.	99.02	.
Others	9.18	1,029	5.85	918
Wave 2	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**
Fertilizer non-organic	96.00	605	98.45	832
Fertilizer	56.00	196	56.59	315
Pesticides (chemicals)	72.00	194	82.95	213
Gasoline for tobacco farming equipment	20.00	387	17.05	314
Oil	10.40	37	9.30	43
Firewood/fuel wood	0.80	.	.	.
Bamboo, bamboo sticks, rice hay, descuke-ride	20.00	.	13.18	.
Knapsack Sprayer	75.20	.	85.27	.
Drums	28.80	.	20.93	.

Sprinkler	55.20	.	32.56	.
Rental of equipment/livestock	41.60	364	54.26	514
Transportation (to market)	67.20	123	69.77	128
Water pump	26.40	.	20.16	.
Mattock, sickle	97.60	.	98.45	.
Others	7.20	502	6.98	426
Wave 3	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**
Fertilizer non-organic	97.69	1,125	97.89	1,249
Fertilizer	53.85	320	50.00	332
Pesticides (chemicals)	81.54	284	85.92	290
Gasoline for tobacco farming equipment	27.69	420	26.76	370
Oil	3.85	97	0.70	18.22
Firewood/fuel wood	0.77	1.8	1.41	114
Bamboo, bamboo sticks, rice hay, descuke-ride	18.46	.	13.38	.
Knapsack Sprayer	83.08	.	85.92	.
Drums	14.62	.	10.56	.
Sprinkler	52.31	.	32.39	.
Rental of equipment/livestock	54.62	482	71.83	765
Transportation (to market)	84.62	279	91.55	240
Water pump	27.69	.	23.24	.
Mattock, sickle	98.46	.	98.59	.
Others	31.54	435	33.10	278
Wave 4	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**	**Proportion of farmers who used the item (%)**	**Average costs (USD PPP)**
Fertilizer non-organic	97.44	953	99.58	1,279
Fertilizer	57.26	285	52.50	315
Pesticides (chemicals)	88.46	276	93.33	310
Gasoline for tobacco farming equipment	26.07	262	20.83	377
Oil	11.11	35	7.92	64
Firewood/fuel wood	0.00	.	0.00	.

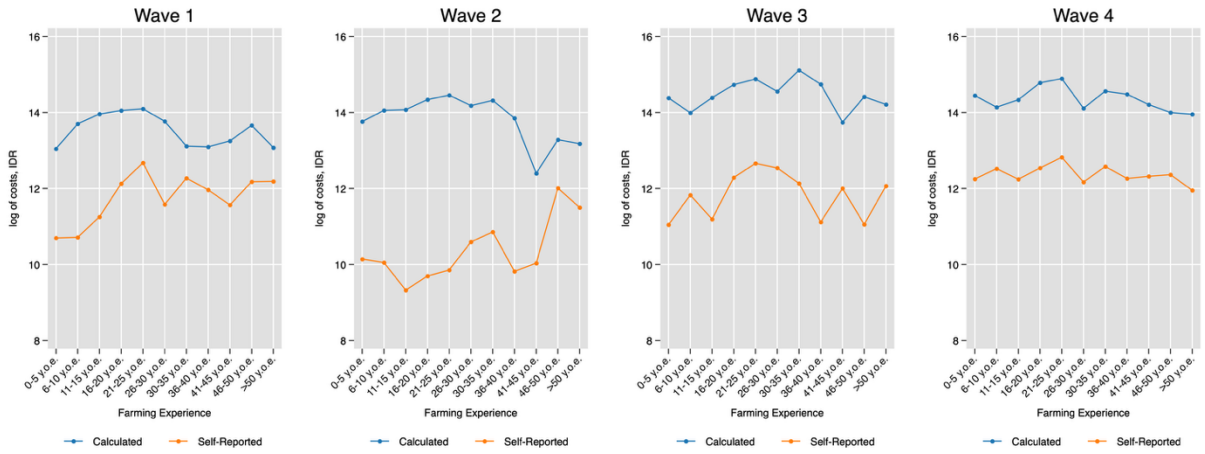
Bamboo, bamboo sticks, rice hay, descuke-ride	11.54	.	7.08	.
Knapsack Sprayer	92.31	.	93.33	.
Drums	29.91	.	14.58	.
Sprinkler	67.52	.	30.42	.
Rental of equipment/livestock	42.74	478	68.33	690
Transportation (to market)	70.09	168	73.75	190
Water pump	30.77	.	22.50	.
Mattock, sickle	97.86	.	98.33	.
Others	14.10	168	7.08	118

Note: The sample in the first wave excludes households from West Nusa Tenggara. The costs in the last three waves of the survey are adjusted for inflation.

We investigated the learning curve farmers experienced concerning estimating their production costs. To facilitate this analysis, we categorized farmers into distinct groups based on their years of experience, with intervals spanning five years. The graphical representation of our findings is depicted in Figure 9.

Our analysis reveals a noteworthy trend: the reported production costs provided by farmers tend to be lower than the actual costs recorded. In the initial survey waves (1 and 2), this discrepancy is more prominent among farmers with relatively less experience, gradually diminishing with more years of experience. Subsequently, in Waves 3 and 4, farm input costs reported by farmers were lower than the actual cost data. Nevertheless, the pattern consistently emerges across groups of farmers with varying years of experience. Notably, the difference between the actual cost data and the farmer-reported cost data narrows in Wave 4, signifying an improvement in farmers' ability to estimate their production costs with the passage of time and experience.

Figure 9. Learning curve of cost estimation for tobacco farmers



Note: The sample in the first wave excludes households from West Nusa Tenggara. The costs in the last three waves of the survey are adjusted for inflation.

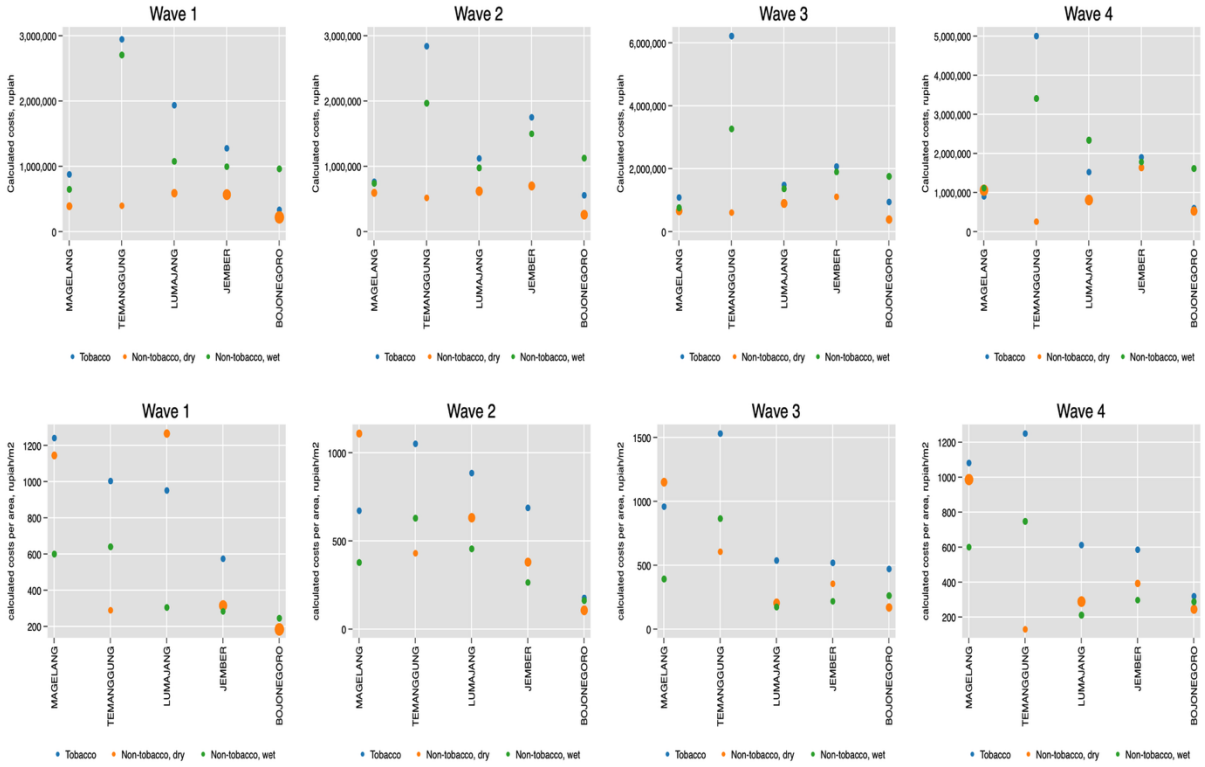
In the context of this study, we have comprehensively investigated the median input costs incurred by tobacco farmers and have further separated the analysis results by relevant region. The breakdown of input costs consists of three categories: tobacco farm input costs, non-tobacco farm input costs in the dry season, and non-tobacco farm input costs in the wet season. Information on the results of this analysis is presented in Figure 10.

From the results of our analysis, tobacco farmers in the Temanggung region bear the highest tobacco farm input costs. This finding is also consistently confirmed across all waves of the survey that we have conducted. In addition, farmers in the Temanggung region always bear the highest input costs for non-tobacco farming during the rainy season. Meanwhile, farmers in the Jember region recorded the highest input costs for non-tobacco farming during the dry season.

There is no notable change in the pattern of input costs between Wave 3 and Wave 4, as can be observed from the entire range of surveys we have conducted. Furthermore, our analysis shows that farmers in the Bojonegoro region consistently bear the lowest farm input costs compared to other areas.

In addition, we conducted the same analysis by considering land size, as shown in the second row of the figure. The results of the analysis show a trend towards higher input costs in the Central Java region. Only in Wave 1 are farmers' input costs per square meter higher in Lumajang than in Temanggung.

Figure 10. Median input costs for tobacco farmers by region, all seasons



Note: The sample in the first wave excludes households from West Nusa Tenggara. The costs in the last three waves of the survey are adjusted for inflation.

We have conducted an in-depth analysis of the labor aspect of tobacco farming, including the inclusion of family members as workers. To provide a comprehensive picture, we present the results of this analysis in Table 17, which shows the median working days of tobacco farmers, taking into account gender and age group.

Our results show that male workers in both tobacco and non-tobacco farming have higher working hours compared to female workers. A potential explanation is that male members do not perform household chores as much as the female members. However, for the younger age group, some data shows a trend towards higher working hours for female workers.

Interestingly, in Wave 4, we found a significant decrease in working hours for tobacco farming workers above 60. For example, in Wave 3, male tobacco farmers in this age group worked an average of 592 hours, and in Wave 4, this figure dropped drastically to 240 hours. In contrast, we observed a significant increase in the working hours of tobacco farmers who handled non-tobacco crops, from 48 working hours in Wave 3 to 120 hours in Wave 4.

Table 17. Hired labor for tobacco farming by gender/adult & child – days

Worker Type	Adult male	Adult female	Child	Adult male	Adult female	Child	Adult male	Adult female	Child	Adult male	Adult female	Child
Wave	**1**			**2**			**3**			**4**		
Nursery	5.71	5.10	-	8.32	5.26	-	4.43	4.00	-	10.48	10.17	-
Land preparation	7.56	6.39	-	6.21	15.18	-	6.33	5.89	-	6.35	7.50	-
Field tending	14.00	13.69	-	9.82	7.27	-	10.18	6.86	-	1.94	2.11	4.00
Harvest	10.27	12.05	-	7.04	7.85	-	8.70	9.19	12.00	7.68	7.59	-
Post-harvest	9.66	9.95	1.60	8.34	7.84	2.40	11.41	8.68	5.00	8.34	10.65	-
Marketing	2.21	1.33	-	3.52	4.33	-	5.29	9.00	-	10.28	11.70	-

Note: The sample in the first wave excludes households from West Nusa Tenggara.

To provide further insights into the labor dynamics in the agricultural sector, we pursue a more in-depth analysis of the workforce by investigating the average number of working days of paid workers by worker characteristics and specific types of jobs in agriculture. In Table 18, our results show that male workers tend to have more working days than female workers. However, some noteworthy exceptions exist, especially regarding harvesting and land preparation work in some survey waves.

In Wave 4, we found a significant decline in the number of working days of adult workers engaged in field maintenance work. The number of working days for adult male workers declined by around 81 percent, while for adult female workers, the decline was around 68 percent. This change caught our attention because this type of work is dominated by the participation of children, who contribute an average of 4 working days. We also found a significant increase in the number of working days for marketing activities. There was an almost two-fold increase in the number of working days for male workers involved in marketing activities. This finding suggests that marketing activities are increasingly the focus of attention and may indicate the growth and expansion of marketing activities in the agricultural sector.

In addition to the characteristics and working hours of tobacco and non-tobacco farm workers, labor cost analysis is essential to provide an in-depth perspective on labor cost trends. Table 20 reports statistical data on the median labor cost of farmers, both hired labor and family members. Our summarized data shows median labor costs are higher in Central Java. We also see that among tobacco-growing households, the median labor cost is found to be higher in tobacco farming. Moreover, these costs are also higher than those of former tobacco farmers. This indicates that tobacco farming requires higher labor costs. This trend was observed in all five regions and all four survey waves. In addition, we

observed a decrease in the labor cost of household members starting from Wave 2. This occurred in all sample groups.

Although there is no noticeable difference in the median labor cost in Wave 4 compared to the previous waves, our analysis found a significant increase in the labor cost incurred by former tobacco farmers, especially those from household members. This phenomenon is observed in almost all survey areas. This increase is prominent, reaching nearly 120 percent and IDR 1,532 million in Wave 4.

Table 18. Median household and hired labor costs (1,000 IDR) for current and former tobacco farmers by region (dry/tobacco season only)

	Current: tobacco									
	Hired					**Household**				
Wave	**1[1]**	**1[2]**	**2**	**3**	**4**	**1[1]**	**1[2]**	**2**	**3**	**4**
Bojonegoro	800	520	700	990	1,890	4,042	4,042	2,334	1,742	2,298
Jember	1,970	1,848	1,977	3,405	2,490	4,851	5,390	1,507	2,230	2,075
Lumajang	1,797	1,735	2,085	2,100	1,160	6,468	6,738	1,750	1,742	1,679
Magelang	1,779	2,000	1,440	4,535	1,120	5,146	5,956	1,715	2,589	2,126
Temanggung	4,060	2,340	2,600	4,170	2,240	6,554	6,807	3,885	4,086	4,253
Total	1,770	1,560	1,525	2,140	2,030	4,923	5,390	2,100	2,266	2,298
	Current: non-tobacco									
	Hired					**Household**				
Wave	**1[1]**	**1[2]**	**2**	**3**	**4**	**1[1]**	**1[2]**	**2**	**3**	**4**
Bojonegoro	300	300	310	1,155	480	2,516	2,515	700	929	689
Jember	700	750	620	840	2,340	1,078	1,078	389	650	625
Lumajang	665	580	870	905	860	2,425	3,099	452	592	1,302
Magelang	4,295	8,400	4,320	700	550	2,431	2,431	750	1,266	1,244
Temanggung	700	712	775	515	400	4,538	4,254	2,143	1,035	354
Total	555	570	610	825	860	2,156	2,425	661	896	766
	Former: non-tobacco									
	Hired					**Household**				
Wave	**1[1]**	**1[2]**	**2**	**3**	**4**	**1[1]**	**1[2]**	**2**	**3**	**4**
Bojonegoro	600	700	390	2,040	977	2,066	2,785	1,167	836	1,072
Jember	1,925	1,550	720	1,250	1,200	2,785	3,396	461	464	1,532

Lumajang	990	990	1,290	830	1,119	4,042	3,485	1,069	697	1,430
Magelang	1,200	1,200	1,500	1,800	2,400	3,160	2,755	1,045	2,279	2,362
Temanggung	2,870	2,727	975	5,000	1,200	3,606	7,658	1,786	2,071	1,116
Total	1,012	1,000	800	1,230	1,150	3,234	3,234	953	697	1,532

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara. [2]The sample is restricted to households that were observed in all survey waves. The costs in the last three waves are adjusted for inflation.

4.3 Child labor in tobacco farming

The data collected on workers' characteristics reveals the presence of child labor in tobacco farming. The phenomenon of child labor in this context is not only associated with limited access to education and lower socioeconomic status, but also raises concerns about potential health risks (the health impact analysis is presented separately at the end of the report).

In Table 19, we summarize our analysis of the types of work performed by children in households actively engaged in tobacco farming, encompassing tasks related to tobacco farming and the cultivation of non-tobacco crops. Moreover, we categorize the analysis based on the child's employment status, distinguishing between household child labor and hired child labor. The results indicate an overall decline in child laborers in tobacco farming over time. Notably, however, the prevalence of child labor is higher in the context of tobacco cultivation than in the cultivation of other crops. An interesting finding is the absence of hired child laborers involved in non-tobacco farming activities across all survey waves.

In Wave 4, we observed an almost complete absence of hired child laborers in tobacco farming. The only activity involving child labor in this context is tending. However, the number of household child laborers participating in tobacco farming remains considerable.

Table 19. Child agricultural labor

	Tobacco				Non-tobacco			
Household Labor	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**
Nursery	4	2	3	1	0	1	1	0
Preparation	2	1	2	2	0	0	0	0
Tending	4	5	9	4	0	5	0	0
Harvest	2	3	6	4	2	6	3	0
Post-harvest	8	13	11	7	0	10	4	0
Selling and marketing	0	0	1	0	1	1	0	0
Working during school hours	4	6	14	5	1	1	-	-
	Tobacco				**Non-tobacco**			
Hired	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**
Nursery	0	0	0	0	0	0	0	0
Preparation	0	0	0	0	0	0	0	0
Tending	0	0	0	3	0	0	0	0
Harvest	0	0	4	0	0	0	0	0
Post-harvest	12	35	28	0	0	0	0	0
Selling and marketing	0	0	0	0	0	0	0	0

Notes: The sample in the first wave excludes households from West Nusa Tenggara.

4.4 Profits

To discern the profit disparity between active tobacco farmers and those who have transitioned to non-tobacco farming, we analyzed the data, and the summarized results are presented in Table 20. Our analysis encompasses both real profit and perceived profit for comprehensive insight. The real profit is defined as tobacco sales minus tobacco farming household labor input costs and labor costs, while perceived profit denotes tobacco sales minus tobacco farming input costs. As tobacco farmers often cultivate other crops during the dry season, we disaggregated the profit of tobacco farmers accordingly.

The findings reveal that tobacco farmers generally profit more than former tobacco farmers. Moreover, the perceived profit of tobacco farmers from non-tobacco crops also surpasses that of their former counterparts. However, when considering the non-tobacco farming labor costs, we discover that in Waves 3 and 4, the profits of former tobacco farmers exceed those of tobacco farmers. This observation emerges despite the summary data reflecting higher input and labor costs for former tobacco farmers in these respective waves. Unaccounted market factors beyond the scope of our survey may also influence this discrepancy.

During the initial wave, we noticed negative profits for tobacco farmers, possibly attributed to unfavorable weather conditions. Subsequently, the profits of tobacco farmers peaked in the second wave, potentially due to favorable tobacco prices during that period. However, in Wave 4, we observed negative real profit in tobacco farming. This could be a result of elevated labor costs as well as declines in both sales volume and tobacco prices.

Table 20. Tobacco (dry) season — median profits per hectare (1,000 rupiahs) — former and current tobacco farmers

	Tobacco farming		**Non-tobacco farming**	
Wave 1	**Real**	**Perceived**	**Real**	**Perceived**
Current	-25,423	-679	-8,767	5,284
Former	.	.	-7,824	3,515
	Tobacco farming		**Non-tobacco farming**	
Wave 2	**Real**	**Perceived**	**Real**	**Perceived**
Current	5,966	17,195	2.85	5,308
Former	.	.	-508	4,970
	Tobacco farming		**Non-tobacco farming**	
Wave 3	**Real**	**Perceived**	**Real**	**Perceived**
Current	5,235	14,154	3,463	8,719
Former	.	.	4,958	8,291
	Tobacco farming		**Non-tobacco farming**	
Wave 4	**Real**	**Perceived**	**Real**	**Perceived**
Current	-1,225	9,448	2,624	7,418
Former	.	.	3,434	7,314

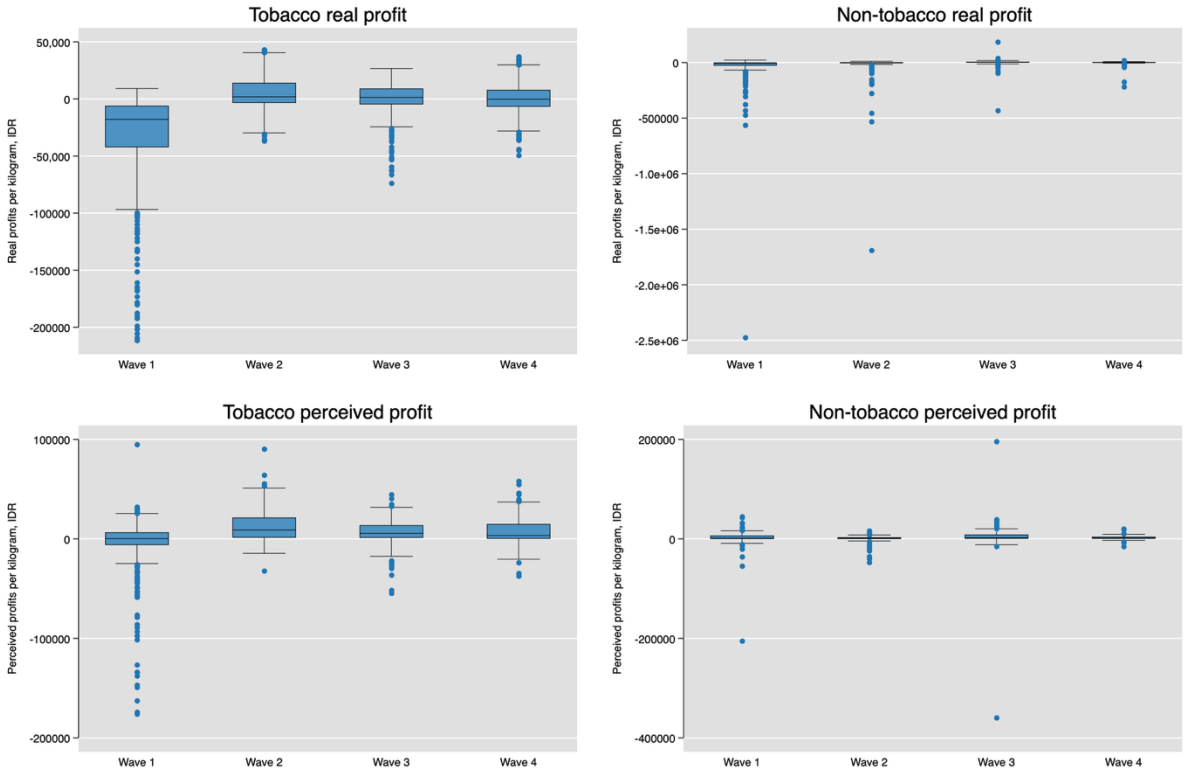
Notes: The sample in the first wave excludes households from West Nusa Tenggara. Real tobacco profit is sales minus tobacco farming, non-household labor input, and household labor costs. Perceived tobacco profit is tobacco sales minus tobacco farming input costs. Per-hectare profit is divided by the total cultivated land for tobacco farming in the dry season. Profits in the second, third, and fourth waves are adjusted for inflation.

Our analysis examined the profit distribution per hectare from tobacco farming, which is visually presented in Figure 11. The findings of this analysis prominently highlight the underperformance of real profit from tobacco farming during Wave 1. Concurrently, we observed that the profit per hectare from non-tobacco crops also exhibited poor results during the same period.

Furthermore, our analysis focused on the increasing number of outliers in perceived profit, signifying farmers' substantial variation in profit expectations. This diverse range of opinions and expectations reflects farmers' disparate

perspectives regarding the profitability of their tobacco farming endeavors. However, it is noteworthy that we discerned no significant difference between Wave 3 and Wave 4 in the distribution of both real and perceived profit. In this context, tobacco and former tobacco farmers demonstrate consistent profit distribution over the study period.

Figure 11. Distribution of profit per hectare of tobacco farming (IDR)



Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara. Real tobacco profit is tobacco sales minus tobacco farming, non-household labor input costs, and household labor costs. In contrast, perceived tobacco profit is tobacco sales, less tobacco farming, and non-labor input costs. Real non-tobacco profit is non-tobacco sales minus non-tobacco farming input costs and household labor costs. In contrast, perceived tobacco profit is non-tobacco sales minus non-tobacco farming input costs. Per-hectare profit is divided by the total cultivated land for tobacco farming in the dry season. Profits in the second, third, and fourth waves are adjusted for inflation.

We continue the profit analysis by breaking down the data to each survey region, and we present the result in Table 21. This granular examination revealed patterns and disparities among the regions. We observed that Jember and Lumajang stand out as the regions with the highest median profit per hectare.

Conversely, Magelang emerged as the region facing the most substantial losses, especially in Wave 1, both in tobacco and non-tobacco crops. In all four survey waves, tobacco farmers in Magelang consistently experienced negative real profits. The sole exception occurred in Wave 4, where a positive real profit was recorded for crops other than tobacco. This notable increase in profit in Wave 4 for Magelang surpassed the gains in different regions, depicting heterogeneity in the profit dynamics among the surveyed areas.

An interesting aspect to explore further is the factors contributing to the consistently negative real profits experienced by tobacco farmers in Magelang and the factors driving the noteworthy increase in profit for crops other than tobacco in Wave 4. A comprehensive analysis of each region's unique economic, agricultural, and market conditions could provide valuable insights into the underlying drivers of these distinct profit trends.

Table 21. Median profit (1,000 IDR) per hectare for current tobacco farmers by region (tobacco/dry season)

	Tobacco: real profit					Tobacco: Perceived profit				
	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4
Bojonegoro	-22,792	-20,893	329	3,101	-1,558	-472	-410	8,654	11,124	7,387
Jember	-22,749	-22,544	30,694	10,492	4,986	-467	-500	44,905	17,467	11,765
Lumajang	-25,371	-23,065	20,553	13,747	17,591	1,250	3,220	32.293	19,632	25,791
Magelang	-72,608	-73,388	-10,489	-5,347	-20,621	-2,976	-5,000	4,828	7,564	1,589
Temanggung	-22,425	-21,956	6,269	2,333	159	-679	-658	19,540	16,480	12,852
Total	-25,423	-23,636	5,966	4,235	-1,225	-679	-520	17,195	14,154	9,448
	Non-tobacco: real profit					Non-tobacco: perceived profit				
	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4
Bojonegoro	-8,092	-11,338	-89	6,124	2,403	6,000	6,151	3,490	11,031	5,101
Jember	-4,743	-5,554	5,854	6,374	7,230	2,920	1,333	11,176	9,654	11,347
Lumajang	-7,337	-17,544	3,919	2,215	-1,111	5,660	9,729	6,640	2,939	1,672
Magelang	-43,247	-21,419	-12,726	-12,836	7,287	11,944	1,900	2,403	8,714	24,177
Temanggung	-28,492	-21,222	-10,051	5,253	-688	6,403	6,827	10,037	21,386	4,285
Total	-8,767	-11,164	2.85	3,463	2,624	5,284	4,985	5,308	8,719	7,418

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara. [2]The sample is restricted to households that were observed in all survey waves. Real tobacco profit is tobacco sales minus tobacco farming, non-household labor input costs, and household labor costs. In contrast, perceived tobacco profit is tobacco sales minus tobacco farming non-household labor input costs. Real non-tobacco profit is non-tobacco sales minus non-tobacco farming input costs and household labor costs. In contrast, perceived tobacco profit is non-tobacco sales less non-tobacco farming input costs. Per-hectare tobacco profit is divided by the total cultivated land for farming in the dry season. Per-hectare non-tobacco profit is profit divided by total cultivated land for non-tobacco farming in the dry season. Profits in the second, third, and fourth waves are adjusted for inflation.

The calculation of the median profit of tobacco farmers in this case may only partially represent the situation well due to the variation in the status of farmers, i.e., between farmers who work independently and farmers who work through contracts. In contrast to the previous analysis, which showed fluctuations, we found that the actual profit per hectare of contracted farmers increased yearly. On the other hand, the median real profit of independent farmers increased in Wave 2, but decreased in subsequent waves.

In this analysis, we find that the median real profit of contract farmers is generally higher than independent farmers. This phenomenon can be explained by possible contributing factors, such as more secure market access, adequate technical support, and a more extensive business scale. In addition, we also found that the perceived profit of contracted farmers tends to be higher than that of independent farmers. While perceived profit is subjective and may be influenced by individual perceptions, it provides relevant information on how these farmers interpret the outcome of their farming business.

Table 22. Median profits per hectare (1,000 IDR) — independent and contract tobacco farmers, by region (tobacco/dry season)

	Contract: real profit (tobacco + non-tobacco)					Contract: Perceived profit (tobacco + non-tobacco)				
	Wave 1[1]	**Wave 1[2]**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 1[2]**	**Wave 2**	**Wave 3**	**Wave 4**
Bojonegoro	-12,611	-11,699	8,727	8,183	-781	4,953	4,460	13,736	9,198	6,810
Jember	-11,841	-10,862	13,419	10,492	20,832	-3,636	-4,393	18,482	23,656	20,932
Lumajang	-23,879	-23,831	14,258	17,984	16,104	995	2,759	21,649	21,960	21,167
Magelang	-73,388	-73,388	-24,680	-	3,828	56,277	56,277	741	-	8,869
Temanggung	-25,241	-16,831	13,078	60,670	5,741	-19,764	-4,675	17,541	66,083	12,852
Total	-16,847	-14,251	10,301	12,479	14,067	896	1,830	17,711	19,138	17,087
	Independent: real profit (tobacco + non-tobacco)					**Independent: perceived profit (tobacco + non-tobacco)**				
	Wave 1[1]	**Wave 1[2]**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 1[2]**	**Wave 2**	**Wave 3**	**Wave 4**
Bojonegoro	-20,875	-20,875	-495	3,455	-858	1,125	1,160	6,391	11,427	8,527
Jember	-21,927	-24,285	29,242	10,489	4,986	1,405	2,982	38,328	16,103	10,149
Lumajang	-21,928	-19,860	13,122	78,205	9,657	7,966	9,801	34,940	13,929	16,528
Magelang	-75,555	-77,166	-6,911	-8,750	-8,142	-2,105	-3,007	6,552	7,929	6,532
Temanggung	-21,956	-21,612	4,240	2,027	-897	20	99	19,382	14,141	11,176
Total	-24,817	-24,419	4,036	3,001	-544	211	809	15,307	113,046	9,901

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara. [2]The sample is restricted to households that were observed in all survey waves. The real profit is real tobacco plus real non-tobacco farming profits, while perceived profit is perceived tobacco and non-tobacco farming profits. Per-hectare profit is divided by total cultivated land for tobacco and non-tobacco farming in the dry season. Earnings in the second, third, and fourth waves are adjusted for inflation.

The objective of a more comprehensive evaluation of farmers' productivity and land use led us to examine the calculation of profit per kilogram, a crucial metric in assessing the efficiency of tobacco production and farmers' profit margins. Through this analysis, we gained valuable insights into the performance of both tobacco and non-tobacco crops in Wave 4, highlighting some noteworthy trends.

The results revealed an overall decline in profits for both tobacco and non-tobacco crops during Wave 4, as presented in Table 23. Despite this general trend, the Lumajang region stood out as an exception, displaying the highest median profit for tobacco. Notably, Lumajang experienced a remarkable increase in median profit of approximately 111 percent in Wave 4. This surge in profitability signals an enhancement in production efficiency and the generation of more lucrative yields. Several factors contribute to this positive development in Lumajang. First, high tobacco sales in this region during the corresponding wave played a pivotal role. Additionally, Lumajang enjoyed a higher price per kilogram of tobacco compared to other regions, further bolstering the profitability of tobacco farmers in the area.

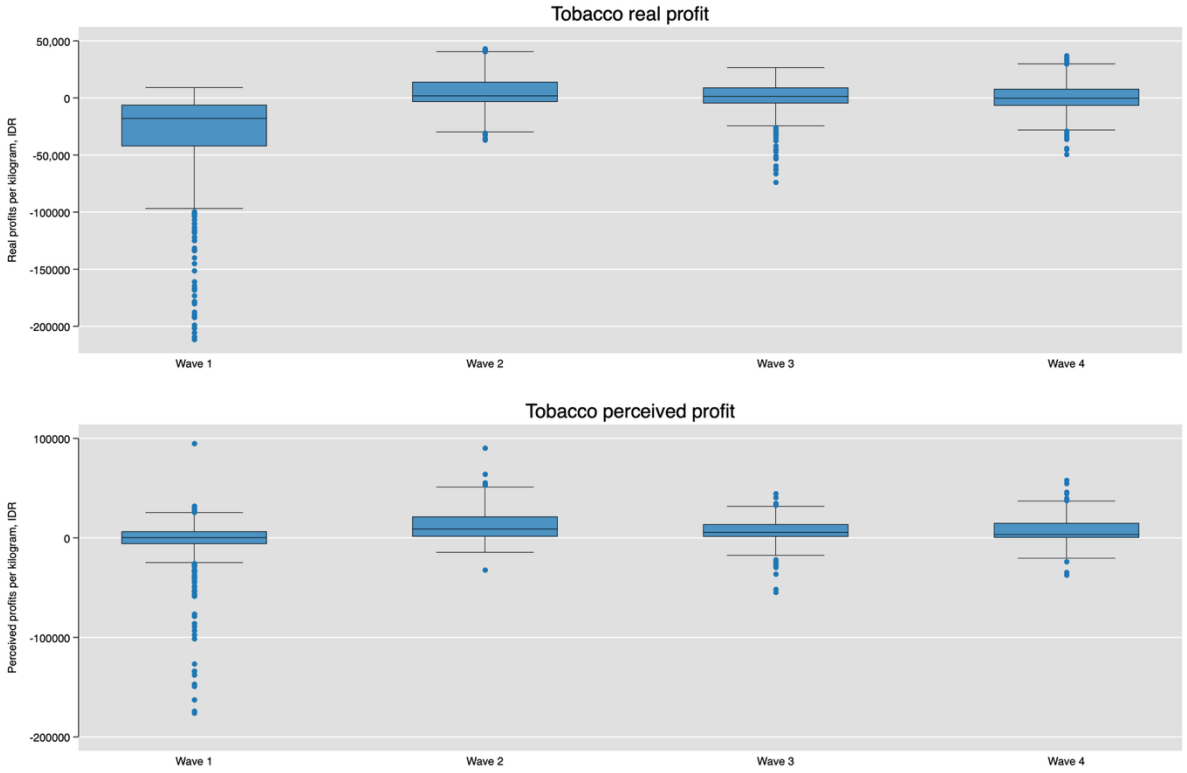
Table 23. Current tobacco farmer median profits per kilogram (IDR rupiah) by region

	Tobacco: Real profit					Tobacco: Perceived profit				
	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4
Bojonegoro	-18,742	-18,691	98	566	-763	593	352	2,670	2,104	1,504
Jember	-23,378	-25,730	16,070	5,948	7,002	1,199	3,026	22,295	10,800	12,762
Lumajang	-23,940	-25,007	9,657	10,424	21,989	2,681	4,552	17,423	15,074	34,989
Magelang	-11,342	-10,990	-2,990	-2,308	-2,671	-284	-334	1,051	1,370	210
Temanggung	-10,545	-11,381	1,353	1,450	658	69	253	7,348	9,636	9,334
Total	-17,921	-19,235	1,875	1,392	-214	343	483	9,211	5,580	4,157
	Non-tobacco: Real profit					Non-tobacco: Perceived profit				
	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4	Wave 1[1]	Wave 1[2]	Wave 2	Wave 3	Wave 4
Bojonegoro	-9,449	-11,554	-189	3,357	296	2,733	2,670	2,516	4,348	2,268
Jember	-2,257	-2,277	74	1,302	941	655	661	816	2,129	1,619
Lumajang	-2,703	-2,751	330	592	-249	763	782	624	1,190	1,746
Magelang	-4,682	-7,698	-1,927	-723	688	666	468	500	1,508	2,030
Temanggung	-15,087	-8,532	-3,183	1,038	-86	4,000	1,618	3,132	4,969	1,597
Total	-5,354	-6,364	-150	1,012	476	1,220	1,077	1,418	2,467	1,774

Notes: [1]The sample in the first wave excludes households in West Nusa Tenggara. [2]The sample is restricted to households that were observed in all survey waves. Per-kilogram tobacco profit is profit divided by total tobacco yield, while per-kilogram non-tobacco profit is profit divided by total non-tobacco yield. Profits in the last three waves are adjusted for inflation.

We present a visual representation of the profit per kilogram data distribution in Figure 12. As observed with profit per hectare, the actual profit per kilogram results in Wave 1 show the lowest performance compared to the other waves. However, the value variation in profit per kilogram is less severe than in profit per hectare. In addition, our analysis found that the actual profit per kilogram showed considerable variation in Wave 4. In this context, we found outliers whose profit values were shallow compared to that wave's average profit.

Figure 12. Distribution of profits per kilogram for current tobacco farmers



Note: The sample is restricted to households observed in all four survey waves. Per-kilogram tobacco profit is profit divided by total tobacco yield, while per-kilogram non-tobacco profit is profit divided by total non-tobacco yield. Profits in the second, third, and fourth waves are adjusted for inflation.

Table 24 presents the median profit per kilogram of former tobacco farmers across different regions. The analysis revealed some notable patterns in fundamental profit changes during Wave 4, with distinct trends observed in the various areas.

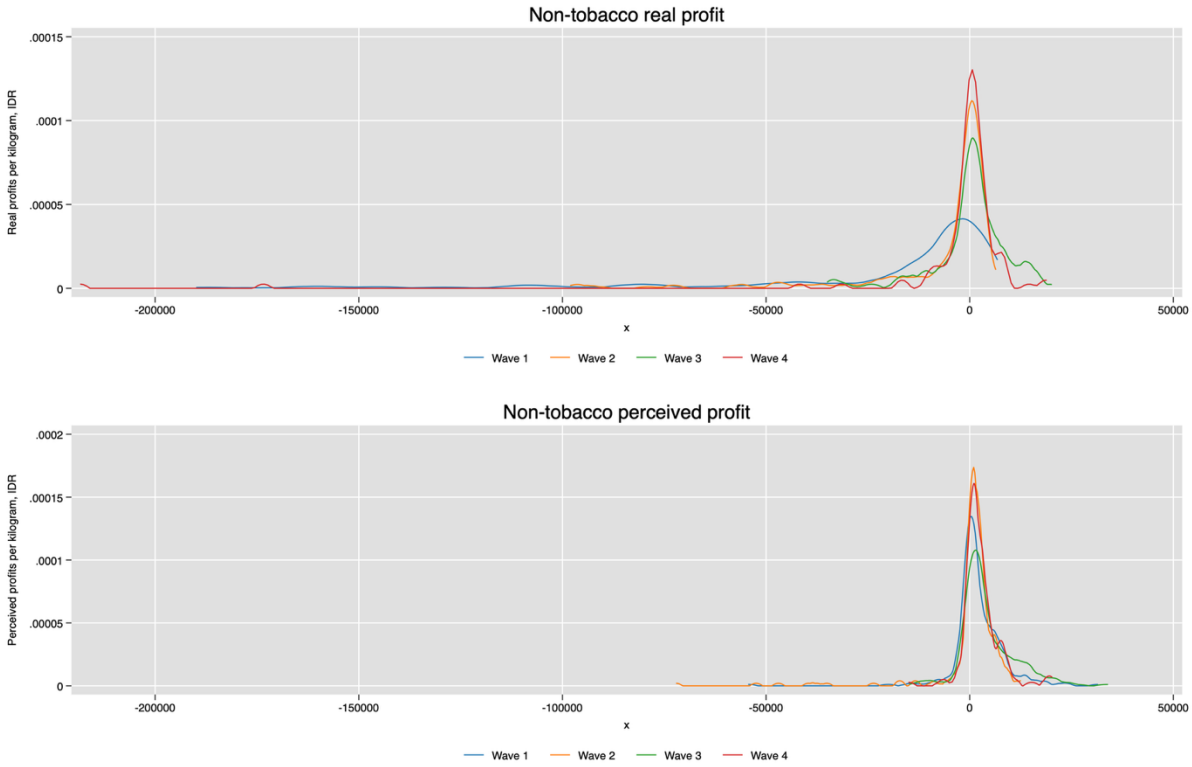
In Central Java, we noted a decrease in real profit for former tobacco farmers in Wave 4, indicating a challenging period for farmers in this region. In contrast, East Java experienced an increase in real profit during the same wave, highlighting a more favorable situation for former tobacco farmers in this area. The Temanggung region consistently emerged with the highest real farm profit across all survey waves. In Wave 4, real earnings in Temanggung reached an impressive IDR 6,280 per kilogram, significantly surpassing profits earned in other regions. Farmers' real profit per kilogram decreased approximately 15 percent from Wave 3. However, despite this decline in actual profit, farmers' perceived profit increased 23 percent during the same period.

Table 24. Former tobacco farmer median profits per kilogram (IDR) by region (tobacco/dry season)

	Non-tobacco: real profit					**Non-tobacco: Perceived profit**				
	Wave 1[1]	**Wave 1[2]**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 1[2]**	**Wave 2**	**Wave 3**	**Wave 4**
Bojonegoro	-7,932	-6,573	-1,751	1,223	1,225	1,651	1,812	930	1,729	2,493
Jember	-724	-141	557	1,344	862	665	915	1,039	1,499	1,536
Lumajang	-1,363	-1,999	82	1,162	293	341	329	984	1,501	924
Magelang	-1,757	-4,718	-127	187	1,151	2,532	1,468	2,436	1,952	3,200
Temanggung	707	-829	-766	4,274	6,280	3,790	3,480	1,302	5,448	10,384
Total	-1,991	-2,180	-271	1,121	948	852	915	1,038	1,550	1,909

Notes: [1]The sample in the first wave excludes households in West Nusa Tenggara. [2]The sample is restricted to households that were observed in all survey waves. Per-kilogram non-tobacco profit is profit divided by total non-tobacco yield. Profits in the last three waves are adjusted for inflation.

Figure 13. Distribution of profits per kilogram for former tobacco farmers



Note: [1]The sample in the first wave excludes households in West Nusa Tenggara. Per-kilogram non-tobacco profit is profit divided by total non-tobacco yield. Profits in the second and third wave are adjusted for inflation.

In Figure 13, we present the distribution of profit per kilogram for former tobacco farmers, shedding light on the dynamics of their profitability over the survey waves. Notably, Wave 3 emerges as the period when farmers achieved optimal profit, as evidenced by the concentration of data points on the right side of the distribution. This observation aligns with the high optimism of farmers during that wave, as reflected in their perceived profit.

However, Wave 4 showcases a different trend, marked by increased variation in farmers' real profits. Consequently, a greater number of farmers experienced below-average profits during this wave. In contrast, the distribution of perceived profits show a more even pattern than the previous waves, indicating a shift in farmers' perceptions of their profitability. This variance between real and

perceived profit distributions may be attributed to changes in the total hours worked by household members on agricultural activities during this period. It is essential to acknowledge that former tobacco farmers derive income from diverse sources beyond agriculture, significantly contributing to their overall income.

Therefore, while this analytical depiction provides valuable insights into the dynamics of profit per kilogram for former tobacco farmers, it should be interpreted cautiously. To comprehensively understand their welfare and economic well-being, it is imperative to consider the broader context of their income sources and livelihood strategies.

In this analysis, we employ the multivariate regression method to discern the factors that may be potential predictors of farmers' income. Our regression specification draws upon Sahadewo et al. (2021):

$$income_{it} = \beta_0 + \beta_1\, tobacco_{it} + \gamma X_{it} + \gamma_s + a_i + u_{it}$$

where i denotes the household, s represents the district, and t indicates the period. The variable *income* represents the total household income per acre of farming land. In contrast, *tobacco* indicates the proportion of a household's land dedicated to tobacco farming. The vector X comprises several household characteristics, including the logarithm of total cultivation area, labor hours, assets, agriculture wage, non-agriculture wage, a binary indicator of whether farmers are engaged in contracts, and demographic information. To account for potential unobservable district-specific traits that may influence income, we include district dummy variables denoted by γ.

Additionally, time-fixed effects are incorporated in the regression model, considering both waves of the TFS data. We cluster the standard errors at the household level to address the potential correlation of unobservable

characteristics or shocks within households across waves. The estimation outcomes are presented in Table 25, providing valuable insights into the relationships between the mentioned variables and household income per acre of farming land.

The findings from our regression analysis yield valuable insights regarding the determinants of farmers' income. Farm size is a critical factor influencing farmers' income, exhibiting a negative relationship with income levels. This implies that larger tobacco land sizes are associated with lower incomes for farmers. The statistical significance of this relationship reinforces its importance to understand the income dynamics of farmers. Moreover, the overall farm size negatively correlates with farmers' income, consistent with Sahadewo et al. (2021) findings. This suggests that larger farm sizes may entail higher expenses in agricultural inputs and labor, potentially surpassing the additional income generated, thereby impacting the farm's overall profitability.

In contrast, non-farm wages positively and significantly contribute to farmers' income, highlighting the significance of diversifying income sources beyond the agricultural sector. This finding underscores the necessity for farmers to seek supplementary sources of revenue to bolster their financial well-being. Additionally, our analysis reveals regional disparities, with farmers in the Temanggung region exhibiting notably higher incomes than their counterparts in other regions. This regional variation may be influenced by diverse factors such as local economic conditions, market access, and government support.

Table 25. Predicting farmers' income

	A:OLS, wave 1	B:OLS, wave 2	C:OLS, wave 3	D: OLS, wave 4	E: OLS, all	F: RE, all	G:FE, all
Share of land for tobacco, %	-160.3***	-41.25	-43.68	-122.6***	-86.52***	-81.41***	-54.71*
	(51.75)	(45.13)	(39.77)	(39.64)	(23.90)	(23.89)	(32.19)
HH total asset, in log	963.3***	518.6***	543.4	-48.51	37.79	29.49	-1.094
	(259.5)	(145.6)	(357.2)	(58.06)	(57.39)	(56.94)	(60.46)
total cultivated land, in log	-1815.7**	-6305.6***	-2703.5***	-2651.1***	-3221.3***	-3253.7***	-3387.0***
	(806.5)	(1335.3)	(660.2)	(644.3)	(484.8)	(484.3)	(541.8)
agricultural wage, log	-169.4*	-100.5	-18.32	-34.46	-104.1***	-101.1***	-76.97
	(86.99)	(75.51)	(42.48)	(72.86)	(36.38)	(36.21)	(47.02)
non-agricultural wage, log	249.3***	144.9*	146.1***	160.8***	173.4***	167.8***	135.9**
	(75.41)	(77.73)	(46.07)	(43.33)	(32.82)	(33.40)	(54.89)
HH labor hours, log	-721.3	-175.2	120.0	-376.2**	-259.2*	-248.2	-197.9
	(541.8)	(260.2)	(103.1)	(166.0)	(156.6)	(154.1)	(154.2)
head of HH age	142.1	-139.3	7.728	4.763	-12.51	-9.204	70.81
	(91.98)	(108.9)	(47.08)	(75.08)	(50.74)	(50.04)	(102.4)
HH size	313.1	466.8	61.80	146.5	282.6	328.2	1072.3
	(746.0)	(702.6)	(304.5)	(482.5)	(304.2)	(299.1)	(746.4)
HH years of schooling	498.3*	-509.8	-21.38	71.79	27.36	19.65	-265.7
	(261.6)	(356.0)	(179.2)	(196.2)	(162.6)	(163.3)	(362.5)

1 if contract farmer	-1329.9	-826.5	2958.6*	-16788.9**	-1656.3	-1896.0	-3218.7
	(2208.7)	(2558.6)	(1540.8)	(8128.3)	(1680.4)	(1698.5)	(1999.0)
1 if Temanggung	6587.7	6797.1*	3397.7	3471.6	5635.7**	5650.4**	.
	(4529.9)	(3919.9)	(2768.0)	(2907.5)	(2297.4)	(2302.7)	.
1 if Lumajang	4145.6	5920.9*	-1500.2	-5602.1*	2121.1	2357.5	.
	(4395.4)	(3463.3)	(2371.9)	(2946.9)	(2081.8)	(2102.3)	.
1 if Jember	3388.0	8434.2**	-1872.2	-9265.3***	1386.7	1544.1	.
	(4337.1)	(3360.5)	(2259.7)	(2808.5)	(1944.5)	(1947.0)	.
1 if Bojonegoro	2314.4	-293.1	-3003.1	-5588.1**	-971.5	-796.3	.
	(3729.1)	(2677.8)	(2199.9)	(2352.9)	(1800.1)	(1812.0)	.
Observations	475	475	475	473	1898	1898	1898
Adj. R-sq	0.0907	0.213	0.140	0.166	0.114		0.0963
F-stats	4.497	5.767	5.427	5.139	9.903		8.913
Controls	Y	Y	Y	Y	Y	Y	Y
Robust S.E.							

Note: The signs *, **, and *** indicate significance at 10, 5, and 1%, respectively. We conduct a robust Hausman test to test the null hypothesis that the difference in FE and RE coefficients is not systematic. We apply the cluster-robust bootstrap procedure and 200 bootstrap repetitions to calculate the robust Hausman test. The Chi-squared test statistics for the robust Hausman test is 6.34 with a p-value of 0.8981.

4.5 Loans for tobacco farming

In this analysis, we aim to investigate the underlying reasons and factors driving the demand for loans among tobacco farmers. As shown in Table 26, from Wave 1 to Wave 3, tobacco farmers' predominant reason for seeking loans was to acquire inputs for their farming activities. However, this pattern underwent a significant shift in Wave 4, where only 13.28 percent of respondents expressed needing loans to support tobacco farming inputs. This change could be attributed, in part, to a decrease in sample size during Wave 4, which may have influenced the distribution of responses.

Instead, in Wave 4, the top two reasons for loan demands among tobacco farmers were acquiring inputs for non-tobacco crops and meeting daily financial needs. These two reasons were also commonly cited in the previous waves, indicating a consistent need for financial assistance to support diversified agricultural endeavors and address everyday expenses.

For former tobacco farmers, the data collected indicated that most of them expressed their need for loans to fulfill agricultural inputs for other crops. This marks a notable shift from the previous wave, where the primary reason for seeking loans in Wave 3 was to meet daily financial needs. This transformation highlights former tobacco farmers' changing economic activities and priorities as they transition to different agricultural pursuits.

Table 26. Reasons reported for needing loans

	Current Wave 1[1]		Current Wave 2		Current Wave 3		Current Wave 4	
	N	Percent	N	Percent	N	Percent	N	Percent
Inputs for tobacco farming	230	35.99	137	29.59	115	25.84	36	13.28
Land for tobacco farming	31	4.85	33	7.13	26	5.84	24	8.86
Inputs for farming other crops	115	18.00	59	12.74	66	14.83	67	24.72

Land for farming other crops	12	1.88	6	1.3	1	0.22	8	2.95
Schooling	37	5.79	29	6.26	37	8.31	11	4.06
Purchasing house	7	1.10	11	2.38	15	3.37	12	4.43
Purchasing vehicle	7	1.10	9	1.94	8	1.80	2	0.74
Investing in business	33	5.16	31	6.7	36	8.09	20	7.38
Special occasions	27	4.23	27	5.83	30	6.74	9	3.32
Meeting daily needs	108	16.90	80	17.28	86	19.33	66	24.35
Health expenses	20	3.13	12	2.59	9	2.02	7	2.58
Other	12	1.88	29	6.26	16	3.60	9	3.32
Total	639	100	463	100	445	100	271	100
	Former Wave 1[1]		**Former Wave 2**		**Former Wave 3**		**Former Wave 4**	
	N	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Inputs for tobacco farming	10	6.45	3	2.75	1	0.64	7	4.38
Land for tobacco farming	3	1.94	8	7.34	1	0.64	1	0.63
Inputs for farming other crops	37	23.87	22	20.18	30	19.23	56	35.00
Land for farming other crops	4	2.58	3	2.75	3	1.92	4	2.50
Schooling	10	6.45	8	7.34	7	4.49	12	7.50
Purchasing house	5	3.23	1	0.92	3	1.92	4	2.50
Purchasing vehicle	3	1.94	3	2.75	10	6.41	4	2.50
Investing in business	22	14.19	19	17.43	24	15.38	28	17.50
Special occasions	14	9.03	12	11.01	7	4.49	5	3.13
Meeting daily needs	39	25.16	20	18.35	57	36.54	28	17.50
Health expenses	7	4.52	4	3.67	5	3.21	4	2.50
Other	1	0.65	6	5.5	8	5.13	7	4.38
Total	155	100	109	100	156	100	160	100

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara.

An analysis examining the factors driving the transition of tobacco farmers to other crops yields valuable insights into the evolving agricultural landscape within a specific region or area. Table 27 presents statistical data that explains the diverse reasons behind this shift. Throughout waves 1 to 4, it becomes

evident that the most prevalent reason for transitioning away from tobacco cultivation is the low price of tobacco. Concurrently, the second dominant factor motivating the shift is the presence of other more lucrative agricultural opportunities. Notably, in Wave 4, approximately 8.4 percent of farmers cited the inability to sell their tobacco crops as a significant reason to pursue other crops. This observation reflects changing market conditions or external factors influencing the market dynamics for tobacco products. Such insights into the challenges and transformations within the agricultural industry are critical in guiding farmers toward potentially more profitable and sustainable alternatives.

Table 27. Reasons given by tobacco farmers for switching from tobacco

	Wave 1[1]		Wave 2		Wave 3		Wave 4	
	N	**percent**	**N**	**percent**	**N**	**percent**	**N**	**percent**
Low price	70	27.45	64	46.38	50	32.68	46	19.33
Unfair grading	5	1.96	10	7.25	10	6.54	5	2.10
Inability to sell crop	25	9.80	24	17.39	23	15.03	20	8.40
More attractive alternatives	28	10.98	27	19.57	49	32.03	13	5.46
Effect on land	22	8.63	2	1.45	5	3.27	-	-
Relationship with contracting company	2	0.78	5	3.62	12	7.84	16	6.72
Extension services	-	-	-	-	-	-	-	-
Other	128	50.20	75	54.35	74	48.37	15	6.30

We investigate why tobacco farmers decided to grow tobacco crops. The reasons we included in the questionnaire were based on previous relevant literature (Chavez et al., 2016; Goma et al., 2017; Magati et al., 2016; Makoka et al., 2017; Drope, Li et al., 2018; Appau, Drope, Witoelar et al., 2019; Appau, Drope, Goma et al., 2019). The results of our analysis are represented in Table 28. From Wave 1 to Wave 2, most farmers chose to grow tobacco because tobacco farming was perceived as a highly profitable venture. This perception differs from former tobacco farmers' reasons in the previous analysis. In Wave 3 and Wave 4, the main reason for switching to tobacco was because they were already familiar

with the business. However, it is essential to note that the reason why tobacco farming is perceived as profitable is still influential in this decision.

In addition, weather also plays a significant role for tobacco farmers. About 45.43 percent of the tobacco farmers in Wave 4 agreed that weather conditions encourage them to tobacco farming. In contrast, this figure could have been higher in Wave 1 as the weather during this period was unfavorable for tobacco farming. Changes in perceptions and more favorable weather conditions in subsequent waves may be critical factors in changing tobacco farmers' decision to plant tobacco crops.

Table 28. Current tobacco farmers' stated reasons for growing tobacco

Reasons	Wave 1[1]	Wave 2	Wave 3	Wave 4
It was a highly lucrative enterprise	73.08	77.73	76.80	47.37
I am used to growing tobacco	28.43	74.02	85.83	63.16
Weather	26.04	65.43	76.39	45.43
Existence of ready market	46.54	60.74	70.43	40.17
Availability of land	39.87	59.18	69.82	41.55
It was the only viable cash crop	56.73	33.98	65.30	30.47
Influenced by other tobacco producers or companies	3.14	3.13	9.86	3.05
Good incentives from the tobacco companies	1.01	2.93	12.73	2.22
To repay outstanding debts from the tobacco	1.01	0.78	2.05	0.00

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara.

5 Well-being

5.1 Asset accumulation

Understanding the welfare level of tobacco farmers is crucial in comprehending their overall quality of life. One essential aspect of assessing their welfare is to examine their assets. In Table 29, we present comprehensive data on the holdings of tobacco farmers, categorizing them into household assets, livestock, and assets used for farming.

Our analysis indicates that most farmers possess essential household assets like televisions, LPG gas, motorcycles, and mobile phones. On the other hand, livestock ownership is more prevalent among former tobacco farmers, likely linked to their diversified income sources compared to tobacco farmers.

Regarding farming assets, almost all farmers surveyed own essential farming equipment like hoes and sickles. However, the ownership of tractors remains relatively low. In Wave 4, only 7.76 percent of tobacco farmers and 10.84 percent of former tobacco farmers owned tractors. This relatively small proportion suggests that most farmers are inclined to employ traditional farming methods. This trend might be attributed to their relatively small farmland size, enabling them to manage the land manually without relying on tractors for their farming activities.

5.2 Food security

In addition to assessing assets, we further examine farmer households' welfare from the food security perspective. Our investigation focuses on two aspects: the quantity of food they produce on their farms and the duration of their food supply. Table 30 shows that former tobacco farmers tend to consume more food from their farms. In Wave 4, approximately 75.87 percent of ex-tobacco farmers grew their food, whereas only 59 percent of current tobacco farmers engaged in

self-production. It is worth noting that this figure represents the lowest percentage compared to the previous waves.

However, when considering the duration of the food supply, we did not find a significant difference between the two groups of farmers. On average, farmers' food supply can last for about eight months, suggesting a considerable level of food security within the surveyed population.

Table 29. Household and agricultural assets — former vs current tobacco farmers (percentage and current value)

	Current								Former							
	Wave 1		Wave 2		Wave 3		Wave 4		Wave 1		Wave 2		Wave 3		Wave 4	
Asset	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value
TV	91.70	300,000	91.41	300,000	93.84	300,000	91.97	1000000	93.33	300,000	89.19	300,000	92.86	300,000	90.21	1,725,000
DVD/VCD player/home theater/radio	43.14	100,000	39.65	75,000	-	-			38.43	100,000	38.51	100,000	-	-		
Satellite Disc	6.54	300,000	7.42	450,000	9.03	400,000	8.03	350000	10.98	325,000	12.84	400,000	11.90	300,000	13.29	550,000
Electric oven/microwave	2.14	100,000	2.15	50,000	3.08	150,000	6.37	900000	1.57	75,000	2.03	25,000	3.57	75,000	8.39	1,500,000
Refrigerator	31.19	575,000	33.01	600,000	42.30	500,000	45.71	1500000	40.00	500,000	40.54	550,000	48.81	500,000	63.99	1,525,000
LPG tube 3kg or more	84.91	100,000	87.70	100,000	93.63	100,000	96.68	150000	89.02	100,000	87.84	100,000	95.24	100,000	97.9	150,000
Washing machine	5.28	600,000	6.84	600,000	9.24	500,000	14.4	1250000	5.49	650,000	5.41	600,000	10.71	500,000	21.33	1,450,000
AC	1.26	100,000	0.39	275,000	1.03	500,000	1.39	3000000	0.78	510,000	2.03	50,000	0.00	-	1.05	

Telephone	0.00	-	0.00	-	0.00	-			0.39	50,000	0.00	-	0.00	-		
Handphone	76.73	150,000	83.40	300,000	85.01	500,000	84.76	1400000	78.82	100,000	79.73	200,000	85.17	500,000	87.41	1,500,000
Computer	7.92	1,500,000	9.18	1,500,000	-	-			9.02	2,000,000	9.46	1,500,000	-	-		
Tablet	6.67	400,000	8.20	362,500	5.75	300,000	1.66	1350000	8.24	400,000	8.78	300,000	4.17	300,000	2.1	
Video camera/camera	1.51	500,000	2.15	600,000	-	-			1.57	525,000	0.68	500,000	-	-		
Water heater	0.50	550,000	0.59	700,000	1.44	500,000	2.22	1600000	0.39	100,000	0.00	-	0.00	-	0.35	
Electric pump	35.60	100,000	35.74	150,000	52.16	150,000	34.9	400000	30.20	100,000	38.51	150,000	58.33	150,000	58.74	500,000
Generator	2.39	800,000	2.15	1,000,000	2.87	875,000	4.71	1700000	4.71	750,000	4.05	900,000	1.19	1,050,000	2.1	
Vehicle	8.05	30,000,000	9.18	32,000,000	11.70	30,000,000	14.96	40000000	8.24	60,000,000	5.41	85,000,000	8.93	60,000,000	10.49	8,000,000
Motorcycle	89.94	5,000,000	92.19	6,000,000	93.84	6,000,000	92.8	16000000	89.41	6,000,000	89.86	7,000,000	91.07	7,000,000	93.71	13,250,000
	Current								**Former**							
	Wave 1		**Wave 2**		**Wave 3**		**Wave 4**		**Wave 1**		**Wave 2**		**Wave 3**		**Wave 4**	

Livestock	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value
Large stocks: cow, buffalo, horse	27.92	15,000,000	31.45	17,000,000	31.62	18,000,000	27.42	20000000	30.98	20,000,000	45.95	18,500,000	44.05	20,000,000	41.26	25000000
Small stocks: Goat, sheep, pigs	31.07	2,000,000	26.37	2,000,000	22.59	3,000,000	24.93	4750000	23.53	2,000,000	20.95	2,000,000	15.48	3,000,000	15.73	4000000
Poultry: Chicken, ducks, geese, quail	43.77	200,000	48.24	250,000	43.12	277,500	28.25	250000	34.51	200,000	55.41	250,000	51.79	280,000	33.22	300000

	Current								**Former**							
	Wave 1		**Wave 2**		**Wave 3**		**Wave 4**		**Wave 1**		**Wave 2**		**Wave 3**		**Wave 4**	
Agricultural and Farming Goods	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value	Owner-ship	Current value
Wagon	6.54	200,000	8.79	200,000	11.70	150,000	13.02	485000	2.35	200,000	6.76	100,000	9.52	125,000	15.03	620000
Plough	1.01	150,000	1.37	7,000,000	0.62	10,000,000	0.83		2.35	1,100,000	1.35	2,005,000	1.19	60,000	3.15	
Tractor	7.17	8,000,000	7.42	8,000,000	9.03	8,250,000	7.76	13000000	5.10	9,000,000	9.46	8,500,000	6.55	8,000,000	10.84	13500000
Water pump	19.62	1,000,000	22.27	800,000	28.95	700,000	24.65	1100000	16.08	700,000	23.65	700,000	27.38	750,000	30.77	2000000

Chopper machine	10.82	1,500,000	14.26	1,500,000	22.38	1,000,000	12.74	3300000	4.71	800,000	4.05	750,000	2.98	600,000	7.34	900000
Sprayer	0.00	-	80.66	150,000	83.98	200,000	89.2	500000	0.00	-	67.57	100,000	76.79	150,000	82.52	500000
Hoe	0.00	-	99.61	50,000	100	50,000	99.17	200000	0.00	-	98.65	30,000	97.02	40,000	96.15	150000
Sickle	0.00	-	98.44	20,000	99.59	20,000	99.17	72500	0.00	-	97.97	20,000	96.43	15,000	98.25	70000
							86.15	50000							83.92	34500
Other, V1	52.45	50,000	11.52	50,000	38.40	20,000	11.63	1300000	51.76	50,000	8.78	20,000	26.79	20,000	8.39	50000
Other, V2	42.77	20,000	1.76	15,000	5.34	22,500	0.55		43.14	20,000	2.03	5,000	5.95	27,500		

Note: The sample is restricted to households observed in both survey waves. Current values of assets in the second and third wave are adjusted for inflation.

Table 30. Staple food production by month

	Current				Former			
	Wave 1[1]	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**
HH produce their own food, %	72.58	73.83	67.76	59	68.23	75.68	73.81	75.87
Longevity of food supply in months, average	7.73	7.02	8.10	8.04	7.40	7.29	7.92	8.83
Months of food supply, month		%				%		
=<1	3.3	7.9	5.2	7.0	5.2	9.8	4.8	1.8
2	4.0	4.5	4.2	3.3	3.5	5.4	3.2	2.3
3	10.8	14.6	8.8	11.7	14.9	11.6	9.7	8.3
4	15.1	10.8	11.5	13.2	12.6	8.0	9.7	11.5
5	4.0	6.4	3.0	4.2	9.2	7.1	5.7	5.1
6	9.2	7.7	10.9	4.7	9.8	8.9	11.3	6.0
7	3.1	4.2	3.9	2.8	0.6	0.0	2.4	1.4
8	6.4	4.5	4.2	4.7	3.5	5.4	8.9	4.6
9	1.9	1.6	3.9	0.5	0.6	3.6	3.2	0.9
10	2.4	3.2	3.3	2.4	2.9	0.9	2.4	3.7
11	0.9	0.8	0.3	0.9	0.0	0.0	0.8	0.5
>=12	38.9	33.6	40.6	44.6	37.4	39.3	37.9	53.9

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara.

In Table 31, we present statistics on how non-food-growing farmers obtain food. Most of the farmers we surveyed obtained their food by purchasing it. In Wave 4, we noted that around 97 percent of tobacco and former tobacco farmers obtained their food through purchase. In addition, we also found an increase in the number of tobacco farmers who obtain their food from the government's rice-for-the-poor assistance program. In Wave 4, this percentage increased to 1.39 percent from 0.41 percent in the previous wave.

Table 31. How non-food-growing farmers acquire food (percentage)

	Current				Former			
Manner of getting staple food	Wave 1[1]	Wave 2	Wave 3	Wave 4	Wave 1[1]	Wave 2	Wave 3	Wave 4
Buy	93.58	91.99	96.71	97.51	93.33	91.22	97.02	97.20
Get for free from rice for the poor program	2.39	2.54	0.41	1.39	3.53	2.7	1.19	1.05
Work for food	0.38	0.59	-	0.28	0.39	0.68	0.6	-
Beg	0.63	0.59	0.41	0.28	1.18	-	0.6	0.70
Other	3.02	4.3	2.46	0.55	1.57	5.41	0.6	1.05
Total observations, N	795	512	487	361	255	148	168	286

Notes: [1]The sample in the first wave excludes households from West Nusa Tenggara.

To gain deeper insights into farmers' food security, we assessed their perception and evaluation of their household's food security. We present the results of this analysis in Table 32, categorized by region. Our findings indicate that most farmers in all areas reported rice as their leading staple food. However, rice is not the dominant leading food in the Magelang region, particularly in Wave 1 and Wave 2. Additionally, we observed that farmers in East Java exhibit a higher tendency to produce more of their food, indicating a higher level of self-sufficiency in the region.

During the survey, we also inquired about farmers' prevalence of food insufficiency. The results reveal that many households in all regions reported needing more food. In Wave 4, approximately 53.85 percent of households indicated that they often face food deprivation, representing an increase from the previous wave. Furthermore, we found a relatively high percentage of farmers—reaching 65.35 percent in Lumajang district—in Wave 4, who reported constantly experiencing food deprivation. Despite the food security challenges observed, we did not identify any significant changes in the average number of farmers' income sources in Wave 4 compared to the previous waves. This finding suggests that the sources of income remained relatively stable, despite the evolving food security situation.

Table 32. Perceived level of food security of current tobacco farmers

	Magelang				Temanggung				Lumajang			
	Wave 1[1]	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**
Rice is the main staple food, %	51.7	41.2	70.8	82.4	88.3	88.5	97.4	100.0	100.0	100.0	100.0	100.0
Produce own food, %	50.0	65.0	36.1	25	28.3	26.9	15.4	12.8	89.3	84.3	91.4	96.9
Level of food security (mode)	3	3	3	4	3	3	3	3	3	3	3	4
Always has sufficient food, %	1.67	5	1.39	1.47	2.50	10.26	5.13	5.13	-	-		
Usually has sufficient food, %	10.03	10	6.94	7.35	9.17	7.69	10.26	-	4	1.2	1.72	3.13
Usually lacks sufficient food, %	61.67	76.25	56.94	33.82	55.83	65.38	47.44	53.85	58.67	63.86	50.00	31.25
Always lacks sufficient food, %	25.83	8.75	34.72	57.35	32.50	16.67	37.18	41.03	37.33	34.94	48.28	65.63
Number of income source, average	0.96	1.21	1.01	1.34	0.94	1.10	0.73	1.18	0.76	0.71	0.71	0.69
Serious switching, %	0.83	13.75	2.78	4.41	2.50	8.97	11.54	6.41	1.33	2.41	1.72	0.00

	Jember				Bojonegoro			
	Wave 1[1]	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**
Rice is the main staple food, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Produce own food, %	80.0	76.8	75.2	76	93.3	97.0	96.4	95.2
Level of food security (mode)	3	3	4	4	3	3	4	4

Always has sufficient food, %	2.08	2.17	2.13	4.00	2.50		0.72	6.02
Usually has sufficient food, %	5.83	7.97	1.42	6.00	5.42	4.51	2.90	2.41
Usually lacks sufficient food, %	51.67	58.7	46.10	42.00	51.25	62.41	46.38	43.37
Always lacks sufficient food, %	40.42	31.16	50.35	48.00	40.83	33.08	50.00	48.19
Number of income source, average	0.62	0.78	0.61	0.85	1.04	1.01	0.96	1.41
Serious switching, %	5.00	2.90	6.38	8.00	4.17	3.01	0.00	1.20

Note: [1]The sample in the first wave excludes households from West Nusa Tenggara.

6 Green Tobacco Sickness

Green Tobacco Sickness (GTS) is a prevailing health concern among agricultural workers in tobacco leaf harvesting and handling. GTS can arise from the absorption of nicotine through both respiratory and skin contact with tobacco leaves (Arcury et al., 2003; Da Mota E Silva et al., 2018). To assess the impact of GTS on respondents, the TFS survey incorporated questions concerning their health conditions. Ideally, farmers' urine or blood would be tested for nicotine absorption, but that is a resource-intensive endeavor and our lack of sufficient resources necessitated a less costly approach. In Table 33, we present data on the history of illnesses experienced by respondents during the last 30 days, categorizing the analysis for both tobacco and former tobacco farmers to facilitate comparison.

Our statistical analysis reveals that the incidence of reported illness is more pronounced among younger age groups, particularly among tobacco farmers. In Wave 4, 40 percent of male children under 15 years old from tobacco-growing households experienced illnesses in the past 30 days, and the corresponding figure for girls was 20 percent. Similarly, among adults, the prevalence of sickness in the last 30 days was higher in tobacco-growing households, suggesting a potential association between direct exposure to tobacco leaves and reported sickness.

Table 33. Reported sickness in last 30 days by gender and age — current and former tobacco farmers

	Current, male				Current, female			
Age group	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**
<15	14.29	0.00	37.50	40.00	33.33	22.22	14.29	20.00
15-20	15.28	31.91	24.39	23.33	17.65	43.48	26.67	50.00
21-35	15.08	39.22	29.46	22.11	15.72	39.31	23.97	21.33
36-60	25.59	50.27	38.53	28.97	26.45	50.87	45.56	29.46

>60	34.23	58.73	47.45	35.90	33.33	56.60	50.00	30.77
	Former, male				**Former, female**			
Age group	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 1[1]**	**Wave 2**	**Wave 3**	**Wave 4**
<15	0.00	0.00	0.00	20.00	0.00	40.00	0.00	0.00
15-20	13.33	28.57	45.45	20.00	0.00	0.00	33.33	20.00
21-35	15.09	31.25	38.71	20.00	14.81	38.24	31.82	21.05
36-60	20.11	35.64	46.00	18.63	27.13	53.26	47.12	23.24
>60	40.00	54.29	45.00	30.00	41.67	66.67	50.00	20.00

Note: [1]The sample in the first wave excludes households from West Nusa Tenggara.

To further investigate the possible GTS experienced by farmers, we collected data on their GTS symptoms. We present the analysis in Table 34. Based on the information provided by the farmers, we observed an increase in GTS symptoms in Wave 2. Interestingly, however, the percentage of occurrence of GTS symptoms decreased in the following waves. In Wave 4, we found that men with GTS symptoms were most prevalent in the mature and middle-aged groups, reaching a range of around 10 percent. On the other hand, GTS symptoms in females were most prevalent in the older age groups, at more than 18 percent. This analysis provides valuable insights into the profile of GTS symptoms among farmers and how they differ by age group and gender.

Table 34. Individuals reporting 1–4 main symptoms* of Green Tobacco Sickness

Male	**Wave 1**	**%**	**Wave 2**	**%**	**Wave 3**	**%**	**Wave 4**	**%**
<21	41	6.55	76	20.54	37	10.14	30	8.67
21-35	30	7.89	53	22.55	35	17.33	23	10.60
36-60	86	10.55	133	27.03	102	21.38	49	10.77
>60	32	13.97	61	17.33	52	8.78	49	6.28
Female	**Wave 1**	**%**	**Wave 2**	**%**	**Wave 3**	**%**	**Wave 4**	**%**
<21	37	6.11	58	15.98	46	13.61	16	5.18
21-35	41	8.42	74	25.96	40	16.19	21	8.33
36-60	104	13.05	168	32.50	149	28.06	60	11.63
>60	19	11.80	52	42.98	51	35.92	29	18.35

Notes: Symptoms of GTS include weakness, headache, nausea, vomiting, dizziness, abdominal cramps, breathing difficulty, abnormal temperature, pallor, diarrhea, chills, fluctuations in blood pressure or heart rate, and increased perspiration and salivation.

7 Conclusion and Policy Recommendations

7.1 Conclusions

The Wave 4 TFS provides comprehensive insight into the livelihoods and the dynamics of tobacco and former tobacco farmers across four different time periods (full growing seasons including both dry and wet). The report analyzes farmers' livelihoods including farming outcomes, profits, and overall household income, among many other characteristics. The report also examines the poverty level and utilization of government social protection programs, offering richer perspectives on farmers' livelihoods. The study's design allows us to compare these measures of livelihoods of current and former tobacco farmers across periods. This study also provides in-depth analyses of the underlying costs of farming, including costs of agricultural inputs, hired labor, and household labor—which farmers sometimes do not account for.

Tobacco farmers who continued growing tobacco stated that their primary reasons were: they are used to growing tobacco; they believe that tobacco farming is a lucrative enterprise; weather; availability of suitable land; the existence of a market for their crop; and that it is the only viable cash crop. Interestingly, the share of tobacco farmers who cited these primary reasons was significantly lower than that of tobacco farmers citing the same reasons in Wave 2 and Wave 3. In general, this finding shows that farmers continue farming tobacco owing to habit and culture and less about economic reasons.

Tobacco farmers continued to experience a profitable year of tobacco farming in Wave 4. However, there are significant differences in the farming outcomes relative to the previous two waves. Specifically, the volume of tobacco sold was lower in Wave 4, primarily driven by lower sales of Burley leaves. Prices per kilogram were slightly higher in Wave 4, driven by higher prices of Virginia, Burley, and Oriental. However, overall sales in Wave 4 declined compared to

Wave 3 and even more compared to Wave 2. The relatively dry weather during the tobacco harvest is one of the primary driving factors of the Wave 4 tobacco farming outcomes. The findings across waves point to the unpredictability and instability of profits for tobacco farming households.

Tobacco farmers bear higher farming costs per hectare than former tobacco farmers. Our estimate suggests that tobacco households bear higher input costs per hectare by almost fivefold. In addition, tobacco farming households also bear higher costs of household labor—nearly three times the household labor costs per hectare—than former tobacco farmers. These findings suggest that tobacco farming is more labor-intensive than former tobacco farming. While the costs of tobacco farming are high, tobacco farmers fail to consider this when calculating profits. We find that the perceived profit is significantly larger than the real profit because farmers generally do not incorporate the opportunity costs of household labor. Furthermore, we find that the variance of tobacco farmers' perceived profit is significantly higher than the variance of former tobacco farmers' profits.

While tobacco farmers experienced another relatively good year of farming compared to historical trends in Wave 4, former tobacco farmers did even better. Our analyses reveal that former tobacco farmers' total household income was higher than current tobacco farmers' income in Wave 4, mimicking the results in Wave 3 TFS. Former tobacco farmers enjoyed higher incomes from non-tobacco crops during the dry season, other enterprises, agricultural wages, and non-agricultural wages. The favorable farming outcomes among former tobacco farmers were driven by better income diversification than current tobacco farmers. Former tobacco farmers are likelier to engage in enterprise, wage-bearing, and other economic activities. Our analyses also replicate previous findings in Sahadewo, Drope, Li, Nargis et al. (2020) that show that a higher share of land dedicated to tobacco farming negatively correlates with farmers' income.

Estimated poverty rates among tobacco and former tobacco farmers were higher in Wave 4 relative to Wave 3. Notably, tobacco farmers' poverty rate was higher than that of former tobacco farmers. Current tobacco farmers are more likely to receive Family Welfare Cards, which are the basis for receiving various social protection programs offered by the government of Indonesia. Tobacco farmers also reported needing loans, primarily to fund inputs for tobacco and non-tobacco farming. In addition, close to a quarter of current tobacco farmers reported needing loans to meet daily needs.

The findings show that while tobacco farming seems profitable—particularly when the weather is desirable—former tobacco farmers continue to perform better economically. Former tobacco farmers have better diversification of primary income sources. They also bear significantly lower costs per hectare of agricultural inputs, hired labor, and household labor inputs. The lower costs, in turn, lead to higher income per hectare among former tobacco farmers than tobacco farmers. We note that a large share of current and former tobacco farmers live in poverty, though the rate was higher among current tobacco farmers. They are also more likely to receive government social protection programs.

7.2 Recommendations

The major recommendations previously shared in the Wave 3 TFS report remain similar, though we use insights from the results of the Wave 4 study to finetune them.

First, the local government should identify and establish agricultural extension services and supporting programs to allow tobacco farmers to transition into non-tobacco cash crops suitable for local conditions and in demand in the local market. The hidden costs borne by government are partly revealed in farmers' access to social programs. The resources dedicated to these programs can be

channeled to the pursuit of alternatives that over time would benefit households who are currently growing tobacco. The TFS surveys suggest that tobacco farmers continue to farm tobacco out of habit, which signifies a need for agricultural extension services. Such a service can provide farmers with farming technology for non-tobacco cash crops, insights about crop prices and demand in the surrounding market, and access to buyers. Local governments can fund these services and programs by using resources from the Dana Bagi Hasil Cukai Hasil Tembakau (Revenue Sharing Funds for Tobacco Products Excise) or DBHCHT and Village Fund (Dana Desa) programs.

Second, the local government should improve supporting farming infrastructure in regions with challenges accessing water during the dry season. Difficulty in accessing water during the dry season has been consistently cited as the primary reason why tobacco is the only viable crop during the dry season. The supporting farming infrastructure may include irrigation systems, deep groundwater wells, and reservoirs. As such infrastructure may help tobacco farmers transition to non-tobacco cash crops, the local government can also consider using resources from the DBHCHT. Local officials can also consider tapping into the funds provided by the Village Fund programs since this infrastructure would improve overall access to water for tobacco and non-tobacco farmers.

Third, in many cases, farmer cooperatives have been shown to improve the livelihoods of their members effectively. Cooperatives allow farmers to pool resources and establish market power collectively. The pool of resources allows farmers to purchase essential agricultural inputs in large quantities and lower prices and transportation modes to distribute farmers' harvest. Sometimes, such cooperatives can also provide informal financing to member farmers who need short-term loans. The market power allows farmers to establish their own value chains or a larger portion of it, without relying on the middlemen who reportedly often extract a significant percentage.

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