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Forest Rights, Dietary Diversity and Nutritional Security of Tribal Communities: Evidence from India

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Abstract

India's indigenous communities (Schedule Tribes or STs) have historically relied on forests for their subsistence, livelihood and cultural identity. Despite this, the STs lacked formal rights to reside in forests and use forest resources under governmental control. In 2008, the Forest Rights Act (FRA) was implemented which granted these STs access to forest land and non-timber forest products (NTFPs). This paper examines the impact of FRA on the dietary diversity of STs. We evaluate this objective by making use of four rounds of a large-scale consumer expenditure survey and use variation in forest cover as a proxy for the potential of the Act to employ a generalised difference-in-differences strategy. We find that post-FRA, dietary diversity of ST households increased in areas with greater forest cover. This increased dietary diversity is driven by an increase in the diversity of vegetables, fruits, and oils consumed. In addition, we find that the sources of food shifted from subsistence-based collection and cultivation to market purchases. Suggestive evidence points to an occupational shift toward non-agricultural employments, particularly in wholesale and retail trade, potentially facilitated by improved NTFP access.

Keywords: FRA, Dietary Diversity, Indigenous Communities, Forest Dwellers, Land Tenure

JEL Code: J15, O15, Q15, Q23

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Abstract

India's indigenous communities (Schedule Tribes or STs) have historically relied on forests for their subsistence, livelihood and cultural identity. Despite this, the STs lacked formal rights to reside in forests and use forest resources under governmental control. In 2008, the Forest Rights Act (FRA) was implemented which granted these STs access to forest land and non-timber forest products (NTFPs). This paper examines the impact of FRA on the dietary diversity of STs. We evaluate this objective by making use of four rounds of a large-scale consumer expenditure survey and use variation in forest cover as a proxy for the potential of the Act to employ a generalised difference-in-differences strategy. We find that post-FRA, dietary diversity of ST households increased in areas with greater forest cover. This increased dietary diversity is driven by an increase in the diversity of vegetables, fruits, and oils consumed. In addition, we find that the sources of food shifted from subsistence-based collection and cultivation to market purchases. Suggestive evidence points to an occupational shift toward non-agricultural employments, particularly in wholesale and retail trade, potentially facilitated by improved NTFP access.

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1 Introduction

Forests offer a host of socio-economic benefits, including the provision of food, medicinal plants, fuel and clean water (Johnson et al., 2013) along with various environmental benefits (Baker and Spracklen, 2019; Spracklen et al., 2012). In India, the indigenous communities (also referred to as the schedule tribes or the STs) have historically constituted the majority of forest dwellers (Kumar and Kerr, 2012). The multifaceted role of forests is particularly significant for these tribal communities who rely on them for their subsistence and livelihood. This dependence includes the collection of non-timber forest products, fuelwood, wild plants, and bushmeat, as well as utilizing forest land for cultivation and grazing.

In the Indian context, both the colonial and postcolonial governments had historically expropriated and asserted control over forests, effectively nullifying the traditional rights of tribal forest dwellers to inhabit and utilize these lands. It is only in recent times that there has been a growing acknowledgment of the critical role forests play in supporting the welfare of these tribal communities and how these communities can contribute to forest conservation efforts. This has culminated into tribals and traditional forest dwellers being granted rights over these forest lands and forest resources. This study examines how granting forest rights impacts the dietary diversity of tribal communities, emphasizing the role of access to forest land and resources in enhancing nutritional security.

The granting of rights over forest land and forest resources for the tribal communities took place in the form of the enactment of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (hereafter, FRA) which got implemented in 2008. One major objective of the FRA has been to guarantee land tenure, livelihood and food security of the scheduled tribes. The Act includes Individual Forest Rights under which tribals can claim upto 4 hectares of land to live in and cultivate. The Act also provides for Community Forest and Forest Resource Rights which recognise the rights of the tribals to own, collect, and use minor forest produce (excluding timber) and make use of grazing lands and water bodies. It also

provides these communities with the right to manage, conserve, and sustainably use forest resources.

We focus on dietary diversity as it is well established that forests contribute positively to dietary diversity and nutritional security (Baudron et al., 2017; Baudron et al., 2019; Olesen et al., 2022). Despite this, the tribal communities which have historically resided in forest areas display poor dietary diversity and nutritional outcomes (Bang et al., 2018; Wahi and Bhatia, 2018). The lack of a diverse diet that is rich in nutrients can lead to micronutrient deficiencies and increase the risk of morbidity and mortality. In case of adults, it can hinder their productivity and work capacity (Dasgupta, 1997; Strauss and Thomas, 1998). In the case of children, the lack of a diverse diet is associated with an increased incidence of stunting, wasting, and being overweight (Yadav et al., 2024; Zeinalabedini et al., 2023). Maternal malnutrition also contributes to poor health outcomes of children and can lead to child and maternal mortality (Black et al., 2008).

In this context, secure rights over forest lands can support sustainable livelihoods, enabling better food availability and dietary choices. Access to forest resources can play a critical role in tribal diets, as wild foods and wild animals directly collected from forests for consumption are nutrient dense and particularly rich in protein and micronutrients (Golden et al., 2011; Nasi et al., 2011; Powell et al., 2011; Boedecker et al., 2014; Fa et al., 2015; Cheek et al., 2023). Furthermore, rights over forest resources can improve diets and nutrition indirectly by generating income through the collection and sale of forest produce (Abdulla, 2013; Derebe and Alemu, 2023).

To quantify the impact of FRA on dietary diversity of the tribal communities in India, we make use of multiple rounds of a large scale consumer expenditure survey from India. Specifically, we make use of the 55th (1999-2000), 61st (2004-05), and 68th (2011-12) consumer expenditure rounds, along with the household consumer expenditure survey (2022-23) conducted by the National Statistical Survey Office (NSSO) under the Ministry of Statistics and Programme Implementation, Government of India. We make use of a generalised difference in differences strategy with variation in forest cover across districts as a measure of variation in exposure to the

Act. Thus, we compare the variation in dietary diversity across areas with low versus high forest cover, before and after the implementation of the Act.

Our findings indicate that post-FRA, dietary diversity of tribal households increased in areas with greater forest coverage- regions where the potential impact of the FRA was more pronounced. The increase in overall dietary diversity is found to be driven by an increase in the number of different vegetables, fruits, and oils consumed. The findings further suggest the presence of heterogeneous effects. FRA had a more substantial impact on households where the household head was literate, likely due to the demand-driven nature of the initiative, which necessitates the submission of applications to secure forest rights, a process potentially more accessible to educated individuals. Moreover, the increase in dietary diversity is found to be more pronounced in areas with a higher proportion of open forests, as these forests are generally more accessible for resource collection.

We ensure the robustness of our results to state specific changes over time, alternative forest cover data, alternative periods of forest cover data, heterogeneous treatment effect. We provide suggestive evidence in favour of parallel trends. We also include state level titles data to further validate our results in the absence of publicly available title distribution data at a more disaggregated level to validate our results.

The findings also indicate a post-FRA shift in food procurement patterns, with tribal households exhibiting greater reliance on market purchases and reduced dependence on subsistence-based home production and free collection. This shift appears to be driven by an income channel. Exploring the mechanism at work, we provide suggestive evidence that changes in food sources are linked to shifts in occupational patterns, with tribal populations moving away from subsistence-based activities toward other forms of employment. Specifically, we observe a decline in dependence on agriculture and forestry and an increase in engagement in retail and wholesale activities. This transition is likely facilitated by improved access to non-timber forest products (NTFPs) following the implementation of the FRA.

The rest of the paper is organised as follows- A review of related literature is presented

in Section 2. Section 3 presents the background on FRA and the pathways by which FRA can impact dietary diversity. Section 4 and Section 5 present the data and methodology and the results. In Section 6, we perform a number of robustness exercises and we explore potential mechanisms in Section 7. Section 8 concludes.

2 Literature Review

Since FRA entails the recognition of land rights of individuals and communities it is broadly related to the body of literature that has focused on evaluating the impact of land reforms and the granting of land rights. Studies have found that land reforms can generate substantial gains in terms of increase in income, consumption, productivity, and a reduction in poverty and inequality (Besley and Burgess, 2000; Banerjee et al., 2002; K. Deininger and Nagarajan, 2009; Montero, 2022; Besley et al., 2016).

Our study also relates to a smaller body of work that has evaluated the granting of rights over forests to the locals and the participation of these locals, particularly indigenous communities, in forest management. A number of these studies have focused on environmental outcomes. A large part of this literature focuses on Latin America, such as, Romero and Saavedra (2021) studied the impact of communal titling on deforestation in Columbia and found that following titling, deforestation in communal lands decreased, particularly in smaller communities. A study by Blackman and Veit (2018) found that forest management by indigenous communities in Bolivia, Brazil and Colombia was associated with decreased deforestation and decreased forest carbon. However, they do not find any impact of indigenous community management on forest outcomes in case of Ecuador. Similarly, Buntaine et al. (2015) examined the impact of a land titling and management program introduced for indigenous communities in Ecuador on deforestation and found that the program did not reduce deforestation. In comparison, Holland et al. (2014) found that deforestation is lower when indigenous areas (where indigenous communities hold communal titles) coincide with forest protection in Ecuador. Other studies have explored similar themes

in Asia and Africa. Persha et al. (2011) evaluated the impact of local forest user participation in forest governance in six countries in East Africa and South Asia and found that when local forest users participate in forest governance, forest systems are more likely to have sustainable results measured in the form of above-average tree species diversity and above average subsistence livelihoods. Chankrajang (2019) found that forests under community forest rights in Thailand were less likely to have forest fires and the intensity of such fires was also less. In the context of India, Baland et al. (2010) found that forests managed by local communities in Uttaranchal in India were less lopped compared to protected state forests and open access forests. Gulzar et al. (2024) found that the grant of greater political representation to indigenous communities in India led to greater forest conservation in the form of reduced deforestation.

Some of these studies also focus on welfare measures, such as, Chhatre and Agrawal (2009) in a study focusing on forest commons across 10 countries found that decentralisation of forest management is associated with not only environmental benefits but is also linked with an improvement in household livelihood. Gelo and Koch (2014) evaluated the impact of a joint forest management initiative in Ethiopia that was introduced along with an improvement in non-timber forest product marketing efforts and found that the initiatives led to an increase in the income of the households from non-timber forest products. Okumu and Muchapondwa (2020) found that a community participation-based reforestation initiative in Kenya increased the income of low-income households by providing landless forest-adjacent communities with opportunities to produce food crops inside forest reserves. However, they found no impact for the poorest. In the context of India, Kumar (2002) found that joint forest management reflects the preferences of the rural non-poor and that it has not generated any benefits for the poor.

This study also relates to the body of work that has focused on evaluating the impact of forests on dietary diversity and health outcomes. Using georeferenced dataset spanning over 34 developing countries, Naidoo et al. (2019) tried to isolate the impact that living near Protected Areas (PA) had on welfare. They found that

PAs had a positive impact on human well being with children living near PAs less likely to be stunted. Rasolofoson et al. (2018) examined the impact that living near forests had on dietary diversity of children in 27 developing countries. They found that at being exposed to forests led children to have 25% greater dietary diversity in comparison to not having such exposure. The result of this exposure to forests was found to hold strongly and positively particularly in case of poor communities. The high exposure to forests was also found to increase the presence of households where children ate food rich in vitamin A and iron. Ickowitz et al. (2014) explored the relationship between tree coverage and dietary diversity of children using DHS data covering 21 African countries and found that living near areas with higher tree coverage translates into better nutritional outcomes for children. In a study focusing on Malawai, Johnson et al. (2013) found that children living in areas which witnessed a net reduction in forest cover over time were less likely to have a diverse diet. It was also found that in areas with larger forest cover, children were more likely to consume food rich in Vitamin A and less likely to suffer from diarrheal diseases.

Our contribution to the literature is twofold. First, while a growing body of research has examined the implications of granting land and forest rights, few studies have considered their effects on dietary diversity and nutritional securityâkey dimensions of human welfare that are particularly relevant for indigenous communities. Second, the existing literature linking forests to dietary diversity largely relies on cross-country correlational analyses. In contrast, this study provides causal evidence from a single-country context by evaluating the impact of a specific policy intervention (the FRA) on the dietary diversity of tribal households. Undertaking such an exercise can offer important implications for other countries where rights over forests and such resources are not defined.

3 Background

3.1 Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Forests have played a de facto crucial role in supporting the livelihood of the STs by providing for the collection of non-timber forest produce, fuel wood, wild plants, bushmeat, and by providing land for grazing and cultivation. These forests have also played a major role in shaping the cultural identity of the STs. However, the STs have been subjected to a history of displacement from forests and denial of rights to use forest resources. The deprivation and displacement dates back to colonial times when the Forest Act of 1865 and 1878 gave power to the government over the use of forests and denied forest dwellers the ability to collect from forests for their personal use (Ambre Rao, 2007). The situation of these tribal communities remained the same even after independence, as postcolonial India saw the implementation of forest laws which aimed at the conservation of wildlife at the expense of forest dwellers. Large parts of forest land were brought under the Wildlife Protection Act in 1972 to protect wildlife but this led to the non-recognition of rights over forests of the tribals (Kumar and Kerr, 2012). Further, the enactment of the Forest Conservation Act of 1980 aimed at ensuring the conservation of forests by giving ultimate authority over the forests to the central government. This worsened the condition of the tribals as it deprived them from being able to collect minor forest produce and to cultivate the forest lands (Wahi and Bhatia, 2018).

The 1990s marked a shift in perspective with the introduction of the Joint Forest Management (JFM) policy which was the first policy that recognized the traditional rights of forest dwellers and involved local communities in forest management and conservation. However, the JFM policy has been unsuccessful in providing any welfare benefits to the participating communities and has displayed poor performance owing to undesirable regulations and poor implementation (Damodaran and Engel, 2003; Kumar, 2002; Sundar, 2001).

All of this resulted in increased dissatisfaction and discontentment among tribal forest dwellers and intensified mobilization for the recognition of their rights over forest land and resources. This culminated in the enactment of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (FRA), which seeks to address the historic lack of recognition of these rights. There are various provisions under the FRA and these include-

Individual Forest Rights (IFR): These IFRs recognize the rights of individuals belonging to STs and other traditional forest dwellers[1] to claim up to 4 hectares of land to live in and cultivate.

Community Rights (CR): These CRs aim at recognising the right of villagers to own, collect, and use minor forest produce (excluding timber) and the right to use grazing lands and water bodies.

Community Forest Rights (CFR): The CFRs deal with the rights to manage, protect, conserve, and govern forests within the traditional boundaries of villages.

Under the FRA, the Gram Sabha is made a key authority in the rights recognition process as title claims are filed with the Gram Sabha [2].

3.2 Pathways by which Forests and FRA can Promote Dietary Diversity

3.2.1 Direct Consumption

Forests serve as a valuable source of diverse fruits, vegetables, and meat. The plant and animal resources available in forests can be directly utilized to fulfill a significant portion of the nutritional requirements of communities residing near forests. These

[1]Scheduled Tribes (STs) who were residing on forest lands prior to 2005 are eligible to file claims under this provision. In the case of traditional forest dwellers, they must provide evidence of residing on forest lands for at least 75 years prior to 2005 to qualify for the granting of titles.

[2]It is important to note that while the Gram Sabha is the body where applications of claims are filed, ultimate acceptance of the application in the hands of the district level committee. The Gram Sabha reviews the application, which are then forwarded to the sub divisional level committees and the the district level committees.

forest derived products are rich in vitamins, minerals, and also have medicinal properties (Dansi et al., 2008; Duguma, 2020; Ullah and Badshah, 2023). By legitimising the rights of the tribals to collect, own, and use minor forest produce (excluding timber), FRA can enhance dietary diversity of the tribals by enhancing their direct consumption of forest items.

3.2.2 Indirect Income

FRA grants the STs the right to reside on and cultivate forest land, enabling them to sustain their livelihoods by selling the agricultural produce they cultivate. Additionally, the Act permits STs to collect non timber minor forest produce and access grazing lands and water bodies, further supporting their economic activities. The income generated through these avenues can be utilized to enhance their nutritional well-being by purchasing a variety of nutrient-rich food items, thereby contributing to improved dietary diversity.

4 Data and Methodology

4.1 Data

We make use of the 55th (1999-200), 61st (2004-05), and the 68th (2011-12) Consumer Expenditure rounds of data, along with the Household Consumer Expenditure Survey (HCES) of 2022-23 [3] collected by the National Sample Survey Office (NSSO). These consumer expenditure rounds collect data on expenditure and quantities purchased of a wide range of both food and non-food items. The food categories covered include cereals, cereal substitutes, pulses, milk and milk products, salt and sugar, oils, eggs, fish and meat, vegetables, fruits, and dry fruits. Along with this, information is collected on the source of the food items purchased by the household- (a)market purchase, (b) home grown, (c) free collection, (d) exchange, or (e) gift/ charity.

[3]The HCES is the successor of the Consumer Expenditure survey but it retains the same purpose of collecting information on household consumption and expenditure

Information on forest cover is obtained from the Forest Survey of India (FSI), under the Ministry of Environment & Forests, Government of India. We make use of the 2001 FSI report. It provides forest cover data across all districts in India. The resolution of this data collected using satellite imagery is 23.5m x 23.5m. The report provides information on two types of forest coverage- dense and open. Dense forests refer to land where forest cover of trees have a canopy density of over 40 percent. Open forests refer to areas where the forest cover of trees have canopy density between 10 to 40 percent. Forest cover is defined including both dense and open forests as per the 2001 report of FSI [4].

We use this forest cover data at the district level as the lowest identifiable unit in NSSO data is the district.

4.2 Variables of Interest

Dietary diversity is an indicator of the range of food available in a household and can contribute to nutritional sufficiency and food security (Hatløy et al., 1998; Ruel, 2003a; Ruel, 2003b; Kennedy et al., 2011). We calculate a dietary diversity score as our main dependent variable by counting the number of different food items purchased by a household. However, aggregating across all types of food categories gives equal weight to all food items and masks important information regarding the type of food consumption that FRA can exert an impact on. To account for this, we also calculate separate diversity indices for the major food categories- cereals, pulses, vegetables, fruits, oil, meats, dry fruits, and milk products. Undertaking such disaggregation is important from the point of view of assessing nutritional security as all food groups may not be equally relevant for nutrition [5]. It has been particularly highlighted that the consumption of fruits, vegetables, and meat is important for the prevention of micronutrient deficiencies, improvement of cognitive functioning, and

[4]Forest cover means all land that is more than 1 hectare in area with tree canopy density above 10 percent.

[5]For example, while cereals may be a good source of macronutrients (such as calories, fats, and protein), the consumption of fruits and vegetables may be more relevant for meeting micronutrient (vitamins and minerals) needs of people.

physical well-being (Neumann et al., 2003; FAO and IFAD, 2012). This disaggregation thus allows us to evaluate if FRA allows STs to access more food items that are relevant from the perspective of nutritional security which these tribals had not been able to incorporate in their diets so far.

While counting the variety in the consumption basked is a qualitative measure of dietary diversity, to get an understanding on the quantitative aspect, we could have looked at the quantities of different food items purchased. However, we are unable to do so due to different recall periods across the different NSS rounds. While the 55th (1999-2000), 61st (2004-05), and the 68th (2011-12) rounds of NSS report quantities purchased and the corresponding consumer expenditure based on a 30 day recall period, the 2022-23 HCES round reports information on all food categories (with the exception of cereals and pulses) based on a seven day recall. This difference in recall makes it difficult to evaluate if FRA had a quantitative impact on the food consumption of individuals.

We present our analysis based on the count measure of dietary diversity. Concerns regarding the difference in recall periods across rounds can seep into our usage of a count measure of dietary diversity. Particularly, there can be concerns regarding variability in consumption that may be captured differently over seven days and 30 days. The different number of food items consumed generally rise with time and then ultimately plateau and assessments of dietary diversity over very short time periods (say, one day) may result in underestimating the true variability in consumption. Prior research suggests that recall periods of at least three days may be useful in addressing concerns regarding variability in consumption (Drewnowski et al., 1997; Ruel, 2003b).

While these differences in recall periods may introduce some measurement noise, they are unlikely to systematically bias our results. In particular, there is no reason to expect that recall periods would vary in a way that is correlated with the percentage of forest cover across districts or the granting of titles under FRA. Any resulting measurement error is likely to be random and is unlikely to confound our estimates of the relationship between forest cover, FRA implementation, and dietary diversity.

FRA can contribute to dietary diversity of tribals directly by granting them the right to use forest produce for their own consumption (consuming fruits, vegetables, and bush meat collected from the forests or by cultivating food on any land granted under the Act) or these tribals can sell their forest collection or what they grow on their land to obtain income to use it for market purchases. We, therefore look at the source from where the STs obtain food items. In particular, we evaluate whether the source of food items that ST households report consuming is market purchase or from free collection and home production. Given that we have multiple food items under different food categories, we again define a count measure of the number of food items under each food category that are obtained from each of the food sources stated.

4.3 Summary Statistics

Table 1 provides some descriptive statistics on the variables used in the analysis. On average, the age of the head of the household in an ST household is around 45 years. Most of the households in our sample are headed by male heads (89.23%). Around 49% of the household heads are non-literate. The average household size of these households is around 5 members. Most of these households have marginal land holdings (60.23 %). 86.54% of these households primarily rely on unclean sources of fuel for cooking.

A brief summary of the consumption patterns of these ST households is provided in Table 2. On average, an ST household's consumption basket is made up of around 18 food items. Pre-FRA, an ST household consumed around 16 food items while the corresponding figure post-FRA is 19 and the difference between the two is statistically significant. While on average ST households consumed around two types of cereals and two types of pulses pre-FRA, this figure significantly rises to three types of cereals and three types of pulses post-FRA. Pre-FRA, an ST household consumed around 7 different types of vegetables while post-FRA, this consumption significantly went up to around 8 vegetables. The consumption of fruits is seen to be very low among ST households, where pre-FRA, ST households on average consumed around one

type of fruit which significantly increased to around two types of fruits post-FRA. Oil consumption is the only food category where we find a significant reduction in consumption post-FRA. We also find that the variety in the consumption of meat, dry fruits and, milk and milk products also significantly goes up post FRA, albeit by a small amount.

4.4 Methodology

Since the FRA was implemented in 2008, we use periods prior to 2008 as the pre-intervention periods and periods after 2008 as the post-intervention periods. We exploit the considerable variation in forest cover across districts to capture differential exposure to FRA. Using these sources of variation, we quantify the impact of the introduction of FRA on the dietary diversity of ST households using a generalised difference-in-differences estimation strategy. This approach closely follows the methodology followed by Nandwani (2022) who also leverages spatial variation in forest cover to estimate the impact of the FRA. The underlying identification assumption is that the FRA is likely to have a greater effect in districts with higher forest cover, where its provisions are more relevant and its potential benefits more substantial.

Our empirical strategy can be defined as the following-

$$y_{idst} = \beta_0 + \beta_1 forest_d \times post_{t>2008} + \beta_2 X'_{idst} + \gamma_d + \gamma_t + e_{idst} \tag{1}$$

Here, y_{idt} is the outcome variable for household i residing in district d and state s at time t. The variable $forest_d$ is the proportion of forest cover in district d in 2001. We use forest coverage data of 2001 as forest cover of later years could be contemporaneously correlated with FRA implementation leading to an issue of endogeneity. $post_t$ is a dummy variable which takes the value 1 for years following the implementation of FRA (that is, years after 2008).

Forest areas tend to be geographically more remote. This means that households

living in districts with larger forest coverage may consistently differ in socioeconomic characteristics from those households that reside in districts with lower forest coverage. This difference in socio-economic status can confound any evaluation of welfare. To account for this, we incorporate X_{idt} which is a vector of control variables at the household level. This includes variables such as age, sex, education level and, marital status of the household head, family size, land holding size, religion, and cooking fuel source. We also incorporate γ_d which represents the district fixed effect to capture district specific characteristics that do not alter over time such as the socio-economic status of the district, location (coastal or not), climatic conditions (temperate, arid, tropical etc.) and the dietary norms that might prevail. Our specification also includes γ_t which represents the round fixed effects.

Our interest lies in estimating β_1, which is the coefficient on the interaction of $forest_d$ and $post_t$, as it captures the impact of FRA in the post-implementation period. Throughout our analysis, we cluster our standard errors at the district level.

As an alterative specification, we interact the $forest_d$ variable with the different rounds of consumer expenditure in an event study specification to get an understanding about the dynamics of the impact of FRA on food security. This can be expressed as-

$$y_{idst} = \beta_0 + \sum_{j=1}^{3} \rho_j (forest_d \times round_{jt}) + \beta_2 X'_{idst} + \gamma_d + \gamma_t + e_{idst} \tag{2}$$

Here, all variables are the same as before but now our interest lies in ρ_j which will capture how dietary diversity changes over time across areas with varying degrees of forest cover.

5 Results

5.1 Dietary Diversity

The results obtained from estimating equation (1) with dietary diversity score as the dependent variable are presented in Table 3. From column (1), we find that post-2008, if the forest cover in a district goes from zero to 100 percent then the overall dietary diversity of ST households rises by approximately 2.2. Relative to the pre-intervention mean, this represents a 14.4% improvement, indicating a notable improvement in dietary diversity following FRA. In simpler terms, this means that post-FRA, moving from a district at the 10th percentile of forest cover (5% area of the district under forest cover) to one at the 90th percentile (55% area of the district under forest cover) is associated with an increase of approximately 1.12 points in dietary diversity for ST households, relative to pre-FRA levels.

Dis-aggregating by food categories, we find that the increase in dietary diversity post-2008 is driven primarily by diversity in consumption of vegetables, fruits, and oil by these ST households. Column (4) shows that the most pronounced impact is observed in the case of vegetables, where diversity in the number of vegetables consumed increases by about 1.3 after moving to a district that is completely covered by forest cover after 2008. This corresponds to almost a 20 % increase relative to the pre-FRA mean. We also find that post-2008, if the forest cover goes from 0 to 100 percent then this leads to an increase of 0.3 (36% increase) and 0.4 (41 % increase) in the dietary diversity of fruits and oils respectively.

Given that FRA is a demand driven initiative which requires individuals eligible under the Act to file claims and for the Gram Sabha to review and forward them for approval, we anticipate 2011-12 to be very close to the year of implementation to generate any positive gains on dietary diversity. By that time, awareness of the claims process was likely to be still limited. This is precisely what we observe from Panel B of Table 3 which presents the results obtained by disaggregated across rounds derived by estimating equation (2). We find that FRA did not lead to any significant gains in diversity of consumption of different food groups in 2011-12. However, we

find that by 2022-23 (when sufficient time had elapsed post-FRA), FRA generates a positive impact on the diversity of consumption of vegetables and oil.

5.2 Dis-aggregated Dietary Diversity

5.2.1 Education

Since rights under the FRA are not automatically conferred, but require claimants to actively file claims, it is possible that individuals with higher levels of literacy are better equipped to navigate this process and successfully secure their entitlements. To assess if this holds in practice, we re-estimate equation (1) by dis-aggregating across those who are illiterate and those who are literate (possessing any level of education). These results are presented in table 4 where Panel (A) corresponds to those who lack any education and Panel (B) corresponds to those who are educated.

Column (1) shows us that after the implementation of FRA in 2008, the increase in dietary diversity among ST households is primarily driven by those who are educated. With a move post-2008, from a district with no forest cover to one with 100 percent forest cover, the dietary diversity increases by 3 for those who are educated. This means that post-2008 with a movement from a district at the 10th percentile to one at the 90th percentile of forest cover, the overall dietary diversity of those who are educated increases by 1.56. In comparison, there is no significant increase in the overall dietary diversity for those who are not educated. For those who are not educated, we only observe an increase in the variety of vegetables consumed. In comparison, for those who are educated, we observe positive and significant increase is the variety of vegetables, fruits, oil, dry fruits, and milk products.

Table A.1 reports the results for different levels of education- primary, secondary, and higher secondary & above. We see that post-2008 with a move to an area with larger forest cover, dietary diversity increases across all levels of education.

5.2.2 Type of Forest Cover- Open or Dense Forests

Open forests and dense forests may impact the dietary diversity of households differently due to differences in their ecological characteristics and accessibility. Dense forests, characterized by thicker canopy cover, provide a range of biological ecosystem services (such as, carbon sequestration, climate regulation, water flow regulation, and soil protection among others). However, their dense nature may limit accessibility for local communities, potentially constraining their direct use for food procurement and other subsistence activities. In comparison, open forests have less dense tree canopy and may be more accessible. This greater accessibility can facilitate the collection of fuelwood, and small-scale commercial activities, potentially influencing household dietary patterns.

From Table 5 it seems that residing in districts with larger share of dense forests contributes more to dietary diversity of ST households. However, dis-aggregating across rounds to understand the dynamic effect (Table A.2), we find that with a move to a district with 100 percent higher open forest cover, on average, the overall dietary diversity of an ST household goes up by around 7 by 2022-23 (in comparison, for dense forest this increase by 2022-23 is insignificant). Increased diversity in the consumption of vegetables, oil, and dry fruits contributes to this. In comparison, the increase in dietary diversity by 2022-23 for those residing around dense forests is restricted to an increase in the diversity of vegetables consumed and smaller in magnitude.

5.3 Source of Purchase

Table 6 presents the results obtained by estimating equation (1) with the count of the number of food items under each food category that were purchased from the market as the dependent variable. We find that post-2008, if there is a move from a district with no forest cover to an area with 100 percent forest cover, the market purchase of vegetables, fruits, oil, and meat go up by 1.43, 0.42, 0.52, and 0.26 respectively.

Results for home grown produce and free collection of food items are presented in

Table 7. Post-2008, with a movement from districts with zero forest cover to 100 percent forest cover, home growing and free collection of cereals, oils and meats goes down by 0.15, 0.04 and 0.31 respectively for ST households. The only instance in which we observe a rise in home cultivation and free collection is in case of dry fruits.

The overall shift from subsistence based home cultivation and free collection to market purchases signals that following the implementation of the FRA, ST households are diversifying their diets through an indirect income channel. The increase in market purchases and decline in subsistence cultivation and free collection is also seen to be more pronounced in case of open forests, which signals that ease in accessing forests for collection of NTFPs is likely to be at work (Table A.3 & Table A.4). Further evidence supporting the role of the indirect channel is presented in Section 7.

6 Robustness

6.1 Other Forest Related Policies

A potential concern in estimating the impact of the Forest Rights Act (FRA) on dietary diversity is the presence of other forest-related policies that may confound our results. However, key forest policies implemented in India either predate the FRA or focus on objectives distinct from those of the FRA. Joint Forest Management (JFM) program, which was introduced in 1990, primarily aimed to consolidate state control over forests or promote co-management between communities and forest departments. JFM did not involve legal recognition of individual or community land rights of tribal forest dwellers. The National Afforestation Programme (NAP) of 2000 and Green India Mission (GIM) of 2014 which subsumed NAP focus on ecological restoration of degraded forests and afforestation funding rather than altering tribal communities' access to forest resources in a legal or redistributive manner. Similarly, fund collected under the Compensatory Afforestation Fund (CAF), established under the CAF Act of 2016, in case of diversion of forest land to non forest use and distributed by state and national Compensatory Afforestation Fund Management

and Planning Authority (CAMPA) focus on afforestation and ecological restoration rather than any rights based redistribution focusing on tribal communities. Thus, these forest centric policies are unlikely to confound our analysis of the FRA's impact on dietary diversity.

Another factor that could potentially influence dietary diversity in forested regions is the presence of mining activity, which is often concentrated in mineral-rich, tribal dominated districts with significant forest cover. However, mining is unlikely to confound our estimates of the FRAâs impact as the variation we exploit in our DiD strategy is based on forest cover and the uniform timing of FRA implementation is not likely to be systematically correlated with mining intensity or expansion.

6.2 State-Time Fixed Effects

To ensure the robustness of our results, we re-estimate equation (1) by incorporating an interaction term for state and round fixed effects. This will account for all unobservable state level factors that vary over time that our likely to confound our estimates such as state level shifts in dietary preferences, implementation of state specific food distribution programmes, and other time-varying state-level changes that may influence individuals' food choices and consumption. The results obtained are presented in Table A.5 and are consistent with those obtained earlier but smaller in magnitude. While the significance of the oil and dry fruits variables is lost, the vegetable variable continues to show significance. As far as the source of food is concerned, we continue to find that market purchases go up while home growing and free collection go down (except for the case of dry fruits).

6.3 Accounting Seasonality

Dietary patterns and market behaviors are subject to significant seasonal variation. As survey timing differs across different districts, failing to control for seasonality could bias our estimates. To address this concern, we include controls for seasonality in the analysis by incorporating fixed effects for the quarter in which the interviews

occurred [6]. The results obtained are presented in Table A.6 and are consistent with our main results.

6.4 Infrastructure Development

An important alternative explanation for the observed increase in dietary diversity, driven by an increase in market purchases of food items post-FRA could be the expansion of infrastructure, particularly roads. Increased road development can improve market access independently of the FRA. If regions with greater forest cover also experienced differential road development during this period, the estimated FRA effect could conflate the impact of land rights with improved market connectivity.

To rule this out, we construct a time varying measure of per capital road length availability at the district level by making use of road length data from International Crops Research Institute for the Semi-Arid Tropics- District Level Data (ICRISAT-DLD). We add this as a control to our main specification. The results obtained are presented in Table A.7 and they remain robust to the inclusion of this control, suggesting that the increase in dietary diversity and market purchases is not simply a consequence of improved infrastructure, but rather can be more directly attributed to the expansion of forest rights under the FRA.

6.5 Alternative Forest Cover Data and Alternative Time Periods

To ensure the robustness of our findings to alternative definitions of forest cover, we re-estimate our results using 2001 forest cover data from the SHRUG database (Asher et al., 2021; Dimiceli et al., 2015), which is obtained from the MODIS Vegetation

[6]The Consumer Expenditure Surveys (CES) were traditionally conducted in four quarterly sub-rounds: JulyâSeptember, OctoberâDecember, JanuaryâMarch, and AprilâJune. The Household Consumer Expenditure Survey (HCES) followed a more granular structure, with data collected across ten sub-rounds/panels. However, these ten sub-rounds encompass the same four core quarters used in the earlier CES rounds. To ensure consistency, we restrict the sample to households surveyed during these four standard sub-rounds in this robustness exercise which reduces the overall sample size.

Continuous Fields (VCF) product. MODIS VCF is based on broad spectrum satellite imagery that assesses tree cover at a 250m resolution and is based on a machine learning algorithm that can distinguish between crops, plantations, and primary forest cover. MODIS VCF provides a continuous estimate of percent tree canopy cover for all land areas and allows us to verify that our results are not sensitive to the FSI's specific definition of forest or its minimum area threshold (1 hectare with at least 10% canopy). The results are presented in Table A.8. In line with the main results, post-2008, we find an increase in dietary diversity with a move to areas with higher forest cover which is driven by an increase in the different types of vegetables, oil and dry fruits consumed. This increase is seen to be driven by an increase in market purchases of food items and a reduction in food sourced from home growing and free collection. The persistence of our findings when using MODIS VCF, which is constructed with a different methodology and spatial logic, provides additional confidence that the observed effects of the FRA are not artifacts of how forest cover is measured.

In addition to this, we also report results using forest cover data from 2004 and 2005, periods still prior to the implementation of FRA[7]. The coefficients remain consistent (Table A.9 & Table A.10), suggesting that the findings are not sensitive to the choice of pre-treatment forest cover period.

6.6 Gardner's Two Stage Difference in Differences

We rely on a difference-in-differences framework for our main analysis. However, even with uniform treatment timing, standard DiD estimates can be misleading in the presence of treatment effect heterogeneity across units or over time. A substantial amount of literature attempts to address the issue of treatment effect heterogeneity in a DiD setting (Roth et al., 2023; Callaway and SantAnna, 2021). To address such concerns, we use the two-stage difference in difference methodology proposed

[7]FRA provided for tenural security to those proving their residence on forest land prior to 13th December, 2005 and provided for rehabilitation of tribals displaced without compensation prior to 13th December, 2005.

by Gardner et al. (2024). This methodology helps in ensuring that our results are robust to treatment effect heterogeneity and captures the hetrogenous treatment effects by allowing for flexibility in how treatment effect evolves over time. A key advantage of this approach is its ability to incorporate continuous treatments, which aligns with the structure of our analysis.

Table A.11-A.12 present the results obtained using this methodology. These results align with the results we obtained using the traditional DiD estimation and are also similar in magnitude. We find that post-2008, with a movement from a district with no forest cover to an area with 100 percent forest cover, overall dietary diversity goes up which is driven by an increase in the diversity in the consumption of items which fall under the categories of vegetables, fruits and oil. We again find that the increase in dietary diversity in the consumption of vegetables, fruits and oil is driven by an increase in market purchases. We observe decline in food items that are home grown or freely collected, with the exception of pulses, dry fruits, and milk, which show an increase.

6.7 Alternative Specification

Till now, our identification strategy has relied on forest cover as a proxy for the potential intensity of FRA implementation under the assumption that districts with more forest had greater scope to benefit from the Act. While this approach is useful, it may be confounded by unobserved factors that are correlated with forest cover. To strengthen causal identification and better capture the actual intensity of FRA implementation, we interact forest cover with the percentage of FRA titles distributed at the state level[8]. Therefore, we now run the following equation-

$$y_{idst} = \beta_0 + \beta_1 forest_d \times titles_{st} + \beta_2 X'_{idst} + \beta_3 titles_{st} + \gamma_d + \gamma_t + e_{idst} \qquad (3)$$

[8]Reports are available online which provide information on FRA title distribution at the state level. Information of title distribution at the district/block/village level is not made publicly available by all states.

Here, all the variables are same as before with the addition of the $titles_{st}$ variable which captures the proportion of titles distributed relative to the total number of claims filed in state s at time t. It is important to note that this variable takes the value 0 in periods prior to 2008 and varies across state and over time in periods post-2008. Estimating equation (3) helps us to validate the credibility of our results as it captures treatment intensity by showing that the impact of FRA depends not only on forest cover/resources but also on title distribution.

The results obtained are presented in Table A.13. Overall, we find that post-2008, with a move to a district with high forest cover and a higher proportion of title distribution, dietary diversity of ST households goes up by around 6.57 (not reported). We find that this increased diversity is driven by an increase in the variety of vegetables, fruits, oil, and dry fruits consumed Panel B shows that the increase in dietary diversity is driven by an increase in the number of fruits, vegetables, oils, meats, and dry fruits which are purchased from the market. Panel C shows that we do find some decline in subsistence sources of obtaining food but this impact is less in magnitude. These results signal that a move from the potential that the Act provides to an actual realization of the Act serves to improve dietary diversity by a larger magnitude. This shows that the impact of FRA depends on both the availability of forest resources and implementation intensity.

6.8 Parallel Trends

The results we have obtained so far can be interpreted as the causal effect of the introduction of FRA on the dietary diversity of ST households if the key identifying assumption of parallel trends is satisfied. This means that prior to the introduction of FRA in 2008, dietary diversify of ST households should have been similar across areas with both low and high forest covers [9]. To check for parallel trends, we limit our sample to the two data rounds that correspond to the pre-FRA periods (the 55th

[9]It could very well be the case that dietary diversity is higher prior to the introduction of FRA for ST households that live in districts with higher forest cover because of higher vegetation in those areas

and 61st NSS rounds, which correspond to the years 1999 to 2000 and 2004 to 2005, respectively) and we interact the *Forest* variable with a dummy variable that takes the value one for 2004-05 and 0 for 1999-2000. In case of a violation of the parallel trends assumption, this interaction term should turn out to be significant.

Table A.14 shows that the coefficients on the interaction terms are insignificant in case of most of the food groups which builds our confidence that the parallel trends assumption is not being violated in case of measuring dietary diversity. In case of dry fruits, we obtain a significant coefficient but it is negative which means that whatever factors are driving this result are unlikely to confound our findings. Similarly, Table A.15 shows that the testing for parallel trends for the sources of food. Most of the coefficients on the interaction terms are again insignificant which build our confidence in our main results. In case of vegetables and dry fruits, we find that as we move from 1999-20 to 2004-05 and with a movement from a district with no forest cover to a district with full forest cover, market purchase of vegetables and dry fruits go down. Whatever is driving this decline is unlikely to drive the increase in market purchases of vegetables that we see post-FRA and therefore, is unlikely to be concerning.

7 Testing for the Income Channel

7.1 Occupational Movement

To understand the factors behind this shift in dietary patterns, driven by a greater reliance on market purchases, we analyze the household type. NSS defines household type based on the primary source of income of the household. Based on the four rounds of NSS data we have used for the analysis, we can identify four household types- self employed in agriculture, self employed in non-agriculture, agricultural labourers, and non-agricultural labourers. We re-estimate equations (1) and (2) using a categorical variable that captures the primary income source of the household. The results obtained are presented in Table 8. We find that post-2008, with a movement from a district with no forest cover to a district with full forest cover, ST households were around 12 percentage points more likely to be self employed in non agricultural

sources of livelihood. We do not find any significant impact on other sources of livelihood (that is, self employment in agriculture, agricultural labourer, and non-agricultural labourer) post-2008. This increase in self-employment in non-agriculture suggests that ST households are not undertaking subsistence cultivation of their own food, which may be leading to a greater reliance on market purchases (supporting an indirect income channel).

To get a better understanding of the type of activities that ST households are turning to, we now evaluate the type of industry of activity that ST households reported being engaged in by making use of the National Industrial Classification (NIC) codes provided in the NSS dataset for these households. Here again, we re-estimate our main equation(s) but with dummy variables capturing the NIC code that the household's primary occupation falls into as the dependent variable. These results are presented in Table 9. We find some evidence that over time there is no increase in the participation of ST households in agriculture and forestry (which goes with the results obtained in Table 8 where we saw no increased involvement in agriculture (as a labourer or in the form of self-employment post-2008 with a shift to districts with greater forest cover). We also find that ST households were not more likely to be involved in manufacturing activities[10] and construction. However, column (4) shows us that ST households reported a greater likelihood of being engaged in retail and wholesale activities post 2008 in areas with larger forest cover. In particular, relative to 1999-2000, with a movement from a district with zero forest cover to full forest cover, ST households were around five percentage points more likely to be involved in manufacturing post- 2008. Evaluating the dynamic effect, With a movement to an area with higher forest cover, ST households were around seven percentage points more likely to be involved in retail and wholesale work in 2022-23 relative to 1999-2000. This provides some suggestive evidence that FRA granted ST households greater rights to forest land and resources, allowing them to engage in small-scale enterprises like collection and processing of non-timber forest products (NTFPs), processing of food, tobacco etc.

[10]Under manufacturing, the type of activities we look at include those related to food, beverages, tobacco, textile, wearing apparel, leather, wood and paper.

It is imperative to note that agriculture and forestry are generally subsistence activities, wherein, households consume most of what they grow or catch/collect. Whereas, manufacturing, and retail/wholesale activities are likely to offer steady and predictable income. The shift in economic activities we observe for ST households signals that these households are shifting towards non-subsistence commercialized sources of livelihoods, which allows them to earn income that can be then used to purchase a range of food items which will contribute to dietary diversity. It is obvious that when households rely on subsistence agriculture and forestry, their diet is restricted to what they grow or catch/collect (Sibhatu and Qaim, 2017) However, with a move to employments that generate stable incomes, households can afford purchasing food from the market such as fruits and vegetables which are more likely to be nutrient dense and will contribute more to dietary diversity (Koppmair et al., 2017; Sibhatu and Qaim, 2017).

7.2 Role of Women

In this section we provide some suggestive evidence that the right to use forest resources in areas with high forest cover can amplify ST womenâs roles in household production relative to men which may eventually be instrumental in enhancing nutritional outcomes.

A large body of literature highlights the critical role of women in influencing the dietary diversity and nutrition status of their households and themselves (Malapit and Quisumbing, 2015; Onah et al., 2021; Gupta et al., 2024). The role of women in influencing dietary diversity can be mediated through their time use across different types of activities- domestic work, cooking, and production activities. Studies have observed that dedicating more time to domestic work and cooking is positively associated with increased dietary diversity (Komatsu et al., 2018; Chaturvedi et al., 2024).

The FRA can enhance women's influence on the nutritional security of their household members by promoting their engagement in activities that support more diverse

diets. To evaluate this potential mechanism, we examine the time ST women dedicate in comparison to ST men to activities that may enhance dietary diversity and nutritional status of the household members. For this, we make use of the Time Use Survey of 2019 conducted by the NSSO. In this survey, data on activity details[11] were collected for each household member aged 6 years and above, covering a 24-hour reference period. This reference period spanned from 4:00 AM on the day prior to the survey interview to 4:00 AM on the day of the interview. To record activities, the 24-hour period was divided into 48 time slots, each of 30 minutes duration.

We estimate the following equation-

$$timeuse_{ihds} = \alpha_0 + \alpha_1 forest_d \times female_{ihds} + \alpha_2 female_{ihds} + \alpha_3 X'_{ihds} + \gamma_d + \gamma_{day} + u_{ihds} \tag{4}$$

Here, $timeuse_{ihds}$ refers to time (in counts of 30 minutes) dedicated to a particular activity by individual i of household h residing in district d in state s. $female_{ihds}$ takes the value 1 if individual i is a female. The vector X includes individual and household specific control variables (such as age, education level, marital status, household size, religion, size of land holding and type of dwelling). The $forest_d$ variable is the same as before and refers to forest cover across districts for 2001. γ_d and $gamma_{day}$ refer to the district and the day of the week fixed effects respectively. Our interest lies in α_1 which captures how participation in activity a differs between females and males with a move from a district with no forest cover to one with full forest cover. As an alternative specification, we re-run equation (4) with household fixed effects. We cluster our standard errors at the district level.

The results obtained are presented in Table 10. We find that with a movement from areas with 0 to 100 percent forest cover (that is, where the potential of FRA is larger), ST women are more likely to devote time towards making and processing

[11]The activity details were coded following the International Classification of Activities for Time Use Statistics 2016 (ICATUS 2016)

food and beverages for use in the household in comparison to ST men. We notice that the role of women in the house is not limited to just food and these ST women living in areas with larger forest cover also devote more time towards making and processing of textiles, apparel, leather for use in the household in comparison to their male counterparts. This underscores the multifaceted contributions made by women to household sustenance[12]. ST women who stay near forests also devote more time relative to men towards gathering firewood and other natural products along with fetching water from natural and other sources for use in the house. This highlights women's critical role in securing the raw inputs necessary for food preparation and overall household functioning. We do not find ST women relative to ST men devoting more time to preparing meals in districts with larger forest cover in comparison to districts with low forest cover. However, these ST women do spend relatively more time serving meals to the household. These results show that ST women have an important role to play in taking care of the household relative to ST men in areas with higher forest cover and higher potential of the FRA. We re-estimate equation (3) for SC women and the results are presented in Table A.16. In areas with larger forest cover, SC women are not more likely to be involved in making and processing food for household consumption relative to men and they are also not likely to spend more time preparing or serving food relative to men. This signals that ST women have a larger potential of impacting the food pattern of their households in areas with larger forest cover.

8 Conclusion

This study analyzes the impact of the Forest Rights Act (FRA) on the dietary diversity of tribal communities in India. Forests have historically played a fundamental role in shaping the cultural identity of tribal populations, who have maintained a deeply interdependent and symbiotic relationship with these ecosystems. These com-

[12]In comparison, we find that in areas with higher forest cover, ST men are more likely to devote higher time towards activities for market production, such as forestry and making and processing goods.

munities have relied on forests for sustenance and livelihood. However, both colonial and postcolonial administrations systematically undermined tribal rights by displacing them from forests and restricting their access to forest resources, including the collection of forest products and cultivation. The FRA was introduced as a corrective measure to address these historical injustices by granting de jure rights over forests and forest resources. The Act formally recognizes the rights of tribal communities to secure their livelihoods through activities such as cultivation, grazing, and the collection of minor forest produce.

Utilizing four rounds of large-scale consumer expenditure surveys and a generalised difference-in-differences approach, this paper finds that dietary diversity among ST households increased post-FRA in districts with higher forest cover. The improvement is driven by a greater consumption of vegetables, fruits, and oils. The effect is stronger among households with educated heads, reflecting the demand-driven nature of the FRA, which requires formal claims. Dietary diversity gains are also more closely linked to open forests, likely due to easier access to non-timber forest products.

We find that the increased dietary diversity is linked to higher market purchases and reduced reliance on subsistence-based food sources (that is, own cultivation and free collection). This signals that an indirect income channel is at work. To investigate this mechanism further, we examine the employment patterns of ST households. The findings indicate that, post-2008, ST households in districts with greater forest cover are more likely to be engaged in self-employment in non-agricultural activities, particularly retail and wholesale trade. This provides suggestive evidence that the FRA may have facilitated access to non-timber forest products (NTFPs), which ST households then utilize for income generation and food purchases from the market.

We also present some evidence that this increase in deitary diversity can result in improved nutritional security as in areas with larger forest cover, ST women are relatively more likely to spend more time in production and processing of food for use in the household, collection of firewood and water, and serving food. This increased involvement in food-related tasks may enhance the availability and utilization of

diverse food resources within the household, thereby supporting better nutritional outcomes.

The findings of this study contribute to the broader literature on property rights recognition by highlighting their welfare impacts. The evidence that the implementation of the FRA led to improvements in dietary diversity, mediated through increased market purchases and shifts toward non-agricultural employment, demonstrates that property rights can contribute to diet diversity and nutrition even if they do not entail direct health or nutrition focused interventions. These findings shows that the benefits of secure property rights extend beyond agricultural productivity or tenure security, emphasizing their role in enabling rural structural transformation by enabling marginalized communities to access and benefit from natural resources. This underscores the importance of property rights recognition in empowering marginalized communities and promoting inclusive development in countries where property rights are not well defined.

9 Tables

Table 1: **Summary Statistics: Household Characteristics**

	(1) Pre-FRA	(2) Post-FRA	(3) Overall
Age	43	46	45
Sex: Male (%)	91.94	87.38	89.23
Sex: Female (%)	8.06	12.62	10.77
Education: Illiterate (%)	57.14	42.9	48.67
Education: Till Primary (%)	24.06	28.03	26.42
Education: Till Secondary (%)	13.57	20.73	17.83
Education: Higher Secondary & Above (%)	5.23	8.34	7.08
Religion: Hindu (%)	91.16	92.47	91.94
Religion: Muslim (%)	0.7	0.38	0.51
Religion: Others (%)	8.14	7.15	7.55
Household Size	5	5	5
Marital Status: Married (%)	85.81	83.93	84.69
Marital Status: Never Married (%)	3.37	2.15	2.64
Marital Status: Widowed/ Divorced/ Separated (%)	10.82	13.93	12.67
Land Class: Landless (%)	2.67	1.69	2.09
Land Class: Marginal (%)	62.82	58.46	60.23
Land Class: Small (%)	17.86	18.68	18.35
Land Class: Medium-Large (%)	16.64	21.16	19.33
Cooking: Unclean (%)	93.89	81.53	86.54
Cooking: Clean (%)	3.84	17.51	11.98
Cooking: Others (%)	2.27	0.95	1.49

Table 2: **Summary Statistics: Difference in Food Consumption Before and After FRA**

	(1) Overall	(2) Pre-FRA	(3) Post-FRA	(4) Difference (2)-(3)	(5) t-value
Dietary Diversity					
Overall Dietary Diversity	17.71	15.50	19.22	-3.71***	-60.07
Cereals	2.72	2.24	3.05	-0.81***	-56.09
Pulses	2.95	2.30	3.40	-1.10***	-61.31
Vegetables	7.35	6.80	7.73	-0.93***	-36.61
Fruits	1.26	0.94	1.49	-0.55***	-43.91
Oil	0.74	1.06	0.52	0.54***	104.73
Meat	1.37	1.35	1.39	-0.05***	-3.69
Dry Fruits	0.47	0.21	0.66	-0.45***	-54.47
Milk and Milk Products	0.84	0.61	0.99	-0.38***	-46.64

Table 3: **Impact of FRA on Dietary Diversity**

	(1) **All**	(2) **Cereals**	(3) **Pulses**	(4) **Veg**	(5) **Fruits**	(6) **Oil**	(7) **Meat**	(8) **Dry Fruits**	(9) **Milk**
Panel A: Aggregated Impact									
Post×Forest	2.231**	0.033	-0.080	1.348***	0.336*	0.425***	-0.122	0.164	0.125
	(0.943)	(0.218)	(0.219)	(0.322)	(0.197)	(0.152)	(0.214)	(0.136)	(0.104)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.465	0.427	0.477	0.374	0.244	0.527	0.450	0.422	0.397
Panel B: Dynamic Impact									
2004-05×Forest	-2.458**	0.075	-0.405	-0.567	-0.594**	-0.086	-0.364*	-0.328***	-0.188*
	(0.986)	(0.281)	(0.293)	(0.416)	(0.231)	(0.098)	(0.188)	(0.101)	(0.106)
2011-12×Forest	-1.507	-0.415	-0.655**	0.626*	-0.341	0.338**	-0.381	-0.481***	-0.199
	(1.082)	(0.276)	(0.273)	(0.374)	(0.240)	(0.142)	(0.286)	(0.127)	(0.131)
2022-23×Forest	2.125	0.336	-0.119	1.248***	0.191	0.399**	-0.295	0.228	0.138
	(1.344)	(0.337)	(0.327)	(0.431)	(0.276)	(0.183)	(0.296)	(0.206)	(0.146)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.468	0.429	0.478	0.374	0.246	0.527	0.451	0.427	0.398
Baseline Mean	15.50	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table 4: **Impact of FRA on Dietary Diversity: Education**

	(1) **All**	(2) **Cereals**	(3) **Pulses**	(4) **Veg**	(5) **Fruits**	(6) **Oil**	(7) **Meat**	(8) **Dry Fruits**	(9) **Milk**
Panel A: Not Educated									
Post×Forest	1.353	-0.064	-0.435	1.469***	0.304	0.202	-0.138	-0.078	0.093
	(1.131)	(0.247)	(0.292)	(0.386)	(0.247)	(0.170)	(0.173)	(0.152)	(0.129)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,845	15,845	15,845	15,845	15,845	15,845	15,845	15,845	15,845
R-squared	0.466	0.464	0.495	0.346	0.269	0.557	0.396	0.444	0.446
Baseline Mean	14.60	2.16	2.22	6.49	0.79	1.05	1.20	0.18	0.51
Panel B: Educated									
Post×Forest	3.105***	0.121	0.158	1.398***	0.398*	0.542***	-0.053	0.336**	0.205*
	(1.103)	(0.262)	(0.204)	(0.384)	(0.238)	(0.146)	(0.254)	(0.134)	(0.120)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,711	16,711	16,711	16,711	16,711	16,711	16,711	16,711	16,711
R-squared	0.460	0.413	0.480	0.403	0.221	0.525	0.493	0.419	0.355
Baseline Mean	16.72	2.35	2.40	7.21	1.14	1.08	1.54	0.25	0.75

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table 5: **Impact of FRA on Dietary Diversity: Dense Forests and Open Forests**

	(1) **All**	(2) **Cereals**	(3) **Pulses**	(4) **Veg**	(5) **Fruits**	(6) **Oil**	(7) **Meat**	(8) **Dry Fruits**	(9) **Milk**
Panel A: Dense Forests									
Post×Dense Forest	3.713**	0.161	-0.100	2.176***	0.610*	0.424*	0.027	0.221	0.194
	(1.517)	(0.352)	(0.377)	(0.522)	(0.313)	(0.247)	(0.275)	(0.202)	(0.144)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.465	0.427	0.477	0.374	0.245	0.524	0.450	0.422	0.397
Baseline Mean	15.50	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Open Forests									
Post×Open Forest	3.084	-0.215	-0.190	2.027***	0.343	1.283***	-0.731	0.357	0.209
	(2.201)	(0.482)	(0.405)	(0.683)	(0.450)	(0.281)	(0.582)	(0.302)	(0.281)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.464	0.427	0.477	0.372	0.244	0.530	0.451	0.422	0.397
Baseline Mean	15.50	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table 6: **Impact of FRA on Source of Purchase: Market Purchase**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Post×Forest	0.066	-0.152	1.429***	0.422**	0.521***	0.260**	0.109	0.057
	(0.224)	(0.197)	(0.330)	(0.186)	(0.157)	(0.131)	(0.140)	(0.107)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.360	0.423	0.338	0.241	0.514	0.369	0.417	0.308
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table 7: **Impact of FRA on Source of Purchase: Home Grown and Free Collection**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Post×Forest	-0.150*	0.075	-0.258	-0.115	-0.041**	-0.310**	0.057**	0.052
	(0.090)	(0.097)	(0.219)	(0.073)	(0.017)	(0.142)	(0.023)	(0.050)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.294	0.239	0.224	0.159	0.088	0.195	0.106	0.227
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table 8: **Impact of FRA on Household Type (Primary Source of Income of the Household)**

	(1)	(2)	(3)	(4)
	Self Employed		**Labourer**	
	Agriculture	**Non-Agriculture**	**Agriculture**	**Non-Agriculture**
Post×Forest	-0.045	0.119***	0.005	-0.020
	(0.060)	(0.044)	(0.054)	(0.045)
Controls	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes
Observations	32,561	32,561	32,561	32,561
R-squared	0.350	0.086	0.256	0.188

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. , *, ** and *** represent significance at .15, .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table 9: **Impact of FRA on Types of Employment**

	(1) **Agriculture & Forestry**	(2) **Manufacturing**	(3) **Construction**	(4) **Retail & Wholesale**
Post×Forest	-0.047	0.010	0.007	0.048**
	(0.051)	(0.014)	(0.051)	(0.021)
Controls	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571
R-squared	0.256	0.041	0.179	0.052

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. ; *, ** and *** represent significance at .15, .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table 10: **Impact of FRA on Time Involvement of ST Women**

	(1) **Making and processing food & beverages for own final use**	(2) **Making and processing textiles & wearing apparel for own final use**	(3) **Collecting firewood & water for own final use**	(4) **Preparing meals**	(5) **Serving meals**
Panel A: Including District Fixed Effects					
Forest×Female	0.030*	0.070***	0.237**	-0.122	0.449***
	(0.015)	(0.022)	(0.107)	(0.136)	(0.140)
Controls	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes
Day of Week Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	27,995	27,995	27,995	27,995	27,995
R-squared	0.034	0.056	0.207	0.544	0.303
Panel B: Including Household Fixed Effects					
Forest×Female	0.043**	0.080***	0.259**	-0.140	0.519***
	(0.018)	(0.024)	(0.114)	(0.129)	(0.160)
Controls	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes
Day of Week Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	27,620	27,620	27,620	27,620	27,620
R-squared	0.400	0.367	0.448	0.658	0.479

Forest represents the proportion of the total area of a district that is covered by forests. *Female* is a dummy variable that takes the value 1 for females. Results are presented for the year 2019 using the Time Use Survey. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

10 Appendix

Table A.1: **Impact of FRA on Dietary Diversity: Different Levels of Education**

	(1) **All**	(2) **Cereals**	(3) **Pulses**	(4) **Veg**	(5) **Fruits**	(6) **Oil**	(7) **Meat**	(8) **Dry Fruits**	(9) **Milk**
Panel A: Primary									
Post×Forest	3.393***	0.356	-0.023	1.428***	0.453	0.584***	0.066	0.299**	0.230*
	(1.156)	(0.252)	(0.232)	(0.423)	(0.276)	(0.148)	(0.218)	(0.152)	(0.118)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,589	8,589	8,589	8,589	8,589	8,589	8,589	8,589	8,589
R-squared	0.495	0.464	0.509	0.433	0.244	0.544	0.502	0.442	0.385
Baseline Mean	15.80	2.24	2.28	6.89	0.98	1.05	1.49	0.20	0.67
Panel B: Secondary									
Post×Forest	2.923**	-0.120	0.295	1.341***	0.245	0.564***	-0.029	0.356**	0.272*
	(1.252)	(0.326)	(0.276)	(0.495)	(0.255)	(0.158)	(0.286)	(0.169)	(0.143)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,787	5,787	5,787	5,787	5,787	5,787	5,787	5,787	5,787
R-squared	0.454	0.403	0.484	0.406	0.219	0.534	0.504	0.453	0.363
Baseline Mean	17.37	2.44	2.48	7.43	1.24	1.10	1.61	0.27	0.80
Panel C: Higher Secondary & Above									
Post×Forest	3.073*	0.140	0.290	1.063	0.714*	0.362*	-0.209	0.465*	0.247
	(1.777)	(0.505)	(0.412)	(0.710)	(0.420)	(0.203)	(0.376)	(0.264)	(0.182)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,245	2,245	2,245	2,245	2,245	2,245	2,245	2,245	2,245
R-squared	0.447	0.413	0.512	0.429	0.266	0.597	0.572	0.436	0.391
Baseline Mean	19.26	2.65	2.74	8.12	1.58	1.17	1.64	0.39	0.98

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.2: **Impact of FRA on Dietary Diversity: Dense Forests and Open Forests (Dynamic Effect)**

	(1) **All**	(2) **Cereals**	(3) **Pulses**	(4) **Veg**	(5) **Fruits**	(6) **Oil**	(7) **Meat**	(8) **Dry Fruits**	(9) **Milk**
Panel A: Dense Forests									
2004-05×Dense Forest	-4.010**	-0.170	-0.600	-1.069	-0.946***	-0.234	-0.280	-0.444***	-0.266*
	(1.551)	(0.392)	(0.466)	(0.728)	(0.364)	(0.157)	(0.305)	(0.141)	(0.150)
2011-12×Dense Forest	-0.051	-0.241	-0.566	1.339**	-0.198	0.312	-0.112	-0.453*	-0.131
	(2.139)	(0.478)	(0.485)	(0.635)	(0.436)	(0.265)	(0.419)	(0.240)	(0.208)
2022-23×Dense Forest	2.119	0.209	-0.384	1.672**	0.195	0.281	-0.144	0.166	0.124
	(2.152)	(0.477)	(0.512)	(0.744)	(0.470)	(0.288)	(0.398)	(0.286)	(0.199)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.466	0.427	0.477	0.375	0.246	0.524	0.450	0.424	0.398
Baseline Mean	15.50	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Open Forests									
2004-05×Open Forest	-3.387	0.847	-0.706	-0.442	-0.875*	0.033	-1.198***	-0.685**	-0.361
	(2.347)	(0.622)	(0.604)	(0.808)	(0.523)	(0.184)	(0.349)	(0.270)	(0.260)
2011-12×Open Forest	-7.226***	-1.539***	-2.027***	0.308	-1.244**	1.022***	-1.635***	-1.412***	-0.699***
	(1.675)	(0.468)	(0.583)	(0.702)	(0.535)	(0.243)	(0.576)	(0.270)	(0.222)
2022-23×Open Forest	6.909***	1.388*	0.402	2.771***	0.626	1.483***	-1.177*	0.923**	0.492
	(2.633)	(0.756)	(0.644)	(0.844)	(0.497)	(0.327)	(0.708)	(0.455)	(0.382)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.470	0.432	0.479	0.373	0.247	0.531	0.452	0.431	0.400
Baseline Mean	15.50	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.3: **Source of Food: Dense Forests**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Market Purchase								
Post×Dense Forest	0.147	-0.266	2.178***	0.703**	0.561**	0.420**	0.121	0.068
	(0.349)	(0.324)	(0.551)	(0.279)	(0.261)	(0.174)	(0.202)	(0.142)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.360	0.423	0.338	0.241	0.510	0.369	0.417	0.308
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel B: Home Grown and Free Collection								
Post×Dense Forest	-0.110	0.159	-0.255	-0.111	-0.068**	-0.318	0.109***	0.122
	(0.155)	(0.180)	(0.355)	(0.116)	(0.027)	(0.193)	(0.041)	(0.075)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.294	0.239	0.224	0.159	0.088	0.193	0.107	0.227
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.4: **Source of Food: Open Forests**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Market Purchase								
Post×Open Forest	-0.001	-0.178	2.469***	0.580	1.469***	0.394	0.296	0.144
	(0.500)	(0.386)	(0.750)	(0.465)	(0.296)	(0.351)	(0.311)	(0.296)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.360	0.422	0.337	0.240	0.518	0.369	0.417	0.308
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel B: Home Grown and Free Collection								
Post×Open Forest	-0.549***	0.020	-0.782*	-0.355**	-0.058	-0.914***	0.047	-0.017
	(0.163)	(0.158)	(0.469)	(0.159)	(0.036)	(0.346)	(0.028)	(0.104)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.295	0.239	0.225	0.160	0.088	0.196	0.105	0.227
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.5: **Robustness: Impact of FRA on Dietary Diversity (Inclusion of State×Round Fixed Effects)**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Dietary Diversity								
Post×Forest	-0.207	-0.033	1.138***	-0.118	0.085	-0.278	0.153	0.102
	(0.231)	(0.276)	(0.324)	(0.203)	(0.082)	(0.212)	(0.110)	(0.119)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State×Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,570	32,570	32,570	32,570	32,570	32,570	32,570	32,570
R-squared	0.448	0.494	0.390	0.263	0.612	0.462	0.455	0.414
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Source- Market Purchase								
Post×Forest	-0.275	-0.019	0.969**	0.076	0.155*	-0.075	0.081	0.016
	(0.243)	(0.248)	(0.383)	(0.195)	(0.087)	(0.145)	(0.113)	(0.115)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State×Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,568	32,559	32,570	32,570	32,570	32,570	32,570	32,570
R-squared	0.377	0.438	0.352	0.263	0.604	0.380	0.449	0.325
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel C: Source- Home Grown and Free Collection								
Post×Forest	-0.025	-0.043	0.102	-0.254***	-0.038**	-0.177	0.067**	0.054
	(0.091)	(0.119)	(0.246)	(0.080)	(0.018)	(0.124)	(0.030)	(0.046)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State×Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,568	32,559	32,570	32,570	32,570	32,570	32,570	32,570
R-squared	0.312	0.251	0.250	0.173	0.098	0.215	0.115	0.237
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.6: **Robustness: Impact of FRA on Dietary Diversity (Controlling for Seasonality in Consumption)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cereals	**Pulses**	**Veg**	**Fruits**	**Oil**	**Meat**	**Dry Fruits**	**Milk**
Panel A: Dietary Diversity								
Post×Forest	-0.064	-0.259	0.959***	0.243	0.410***	-0.196	0.032	0.038
	(0.238)	(0.216)	(0.319)	(0.222)	(0.150)	(0.203)	(0.111)	(0.102)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,084	24,084	24,084	24,084	24,084	24,084	24,084	24,084
R-squared	0.412	0.496	0.436	0.255	0.472	0.454	0.418	0.401
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Source- Market Purchase								
Post×Forest	-0.065	-0.266	0.877***	0.267	0.488***	0.125	-0.011	-0.019
	(0.223)	(0.200)	(0.315)	(0.199)	(0.156)	(0.139)	(0.112)	(0.098)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,082	24,073	24,084	24,084	24,084	24,084	24,084	24,084
R-squared	0.332	0.430	0.385	0.251	0.443	0.358	0.412	0.299
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel C: Source- Home Grown and Free Collection								
Post×Forest	-0.132	0.014	-0.028	-0.064	-0.032*	-0.247*	0.046***	0.028
	(0.100)	(0.095)	(0.208)	(0.076)	(0.017)	(0.141)	(0.017)	(0.047)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,082	24,073	24,084	24,084	24,084	24,084	24,084	24,084
R-squared	0.310	0.259	0.269	0.180	0.090	0.214	0.126	0.246
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.7: **Robustness: Impact of FRA on Dietary Diversity (Controlling for Per Capita Road Availability)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cereals	**Pulses**	**Veg**	**Fruits**	**Oil**	**Meat**	**Dry Fruits**	**Milk**
Panel A: Dietary Diversity								
Post×Forest	0.060	-0.159	1.629***	0.183	0.464***	-0.181	-0.053	0.058
	(0.286)	(0.255)	(0.449)	(0.232)	(0.164)	(0.276)	(0.161)	(0.123)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,568	26,568	26,568	26,568	26,568	26,568	26,568	26,568
R-squared	0.449	0.467	0.385	0.237	0.550	0.423	0.422	0.401
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Source- Market Purchase								
Post×Forest	0.080	-0.275	1.804***	0.264	0.597***	0.283**	-0.135	-0.056
	(0.275)	(0.224)	(0.379)	(0.214)	(0.177)	(0.126)	(0.165)	(0.107)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,566	26,559	26,568	26,568	26,568	26,568	26,568	26,568
R-squared	0.377	0.418	0.356	0.237	0.538	0.322	0.418	0.307
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel C: Source- Home Grown and Free Collection								
Post×Forest	-0.110	0.126	-0.267	-0.106	-0.054***	-0.366*	0.079**	0.103*
	(0.116)	(0.130)	(0.302)	(0.083)	(0.018)	(0.190)	(0.034)	(0.059)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,566	26,559	26,568	26,568	26,568	26,568	26,568	26,568
R-squared	0.296	0.232	0.244	0.180	0.095	0.220	0.108	0.235
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.8: **Robustness: Impact of FRA on Dietary Diversity (Using Alternative Forest Cover Data)**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Dietary Diversity								
Post×Forest	-0.268	-0.476	1.623**	0.312	1.435***	-0.589	0.485*	0.053
	(0.446)	(0.481)	(0.657)	(0.372)	(0.222)	(0.507)	(0.254)	(0.241)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.427	0.477	0.372	0.244	0.535	0.451	0.423	0.397
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Source- Market Purchase								
Post×Forest	0.061	-0.855*	3.146***	0.588	1.591***	0.649**	0.471*	0.132
	(0.445)	(0.491)	(0.761)	(0.360)	(0.226)	(0.306)	(0.258)	(0.238)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.360	0.423	0.338	0.240	0.523	0.369	0.417	0.308
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel C: Source- Home Grown and Free Collection								
Post×Forest	-0.435***	0.423***	-1.645***	-0.210	-0.042	-0.937***	0.034	-0.074
	(0.165)	(0.140)	(0.404)	(0.149)	(0.029)	(0.274)	(0.021)	(0.096)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.294	0.239	0.227	0.159	0.088	0.198	0.105	0.227
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.9: **Robustness: Impact of FRA on Dietary Diversity (Using Alternative Forest Cover Data from 2004)**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Dietary Diversity								
Post×Forest	-0.392	-0.288	1.206**	0.321	1.340***	-0.669	0.427*	0.028
	(0.376)	(0.401)	(0.555)	(0.335)	(0.199)	(0.429)	(0.227)	(0.212)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.427	0.477	0.372	0.244	0.536	0.451	0.423	0.397
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Source- Market Purchase								
Post×Forest	-0.107	-0.625	2.606***	0.587*	1.483***	0.539**	0.420*	0.154
	(0.388)	(0.409)	(0.621)	(0.328)	(0.203)	(0.261)	(0.230)	(0.213)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.360	0.423	0.338	0.240	0.524	0.369	0.417	0.308
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel C: Source- Home Grown and Free Collection								
Post×Forest	-0.396***	0.382***	-1.477***	-0.201	-0.027	-0.908***	0.027	-0.107
	(0.141)	(0.119)	(0.343)	(0.132)	(0.026)	(0.238)	(0.018)	(0.082)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.294	0.239	0.227	0.159	0.088	0.199	0.105	0.227
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.10: **Robustness: Impact of FRA on Dietary Diversity (Using Alternative Forest Cover Data from 2005)**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Dietary Diversity								
Post×Forest	-0.365	-0.350	1.192**	0.291	1.410***	-0.724	0.466**	0.006
	(0.395)	(0.433)	(0.567)	(0.357)	(0.208)	(0.454)	(0.235)	(0.225)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.427	0.477	0.372	0.244	0.536	0.451	0.423	0.397
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Source- Market Purchase								
Post×Forest	-0.013	-0.691	2.772***	0.556	1.538***	0.598**	0.462*	0.154
	(0.408)	(0.436)	(0.681)	(0.350)	(0.211)	(0.277)	(0.238)	(0.228)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.360	0.423	0.338	0.240	0.524	0.369	0.418	0.308
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel C: Source- Home Grown and Free Collection								
Post×Forest	-0.435***	0.388***	-1.626***	-0.220	-0.017	-1.001***	0.027	-0.121
	(0.139)	(0.123)	(0.379)	(0.135)	(0.027)	(0.242)	(0.019)	(0.085)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.294	0.239	0.227	0.159	0.088	0.200	0.105	0.227
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.11: **Robustness: Impact of FRA on Dietary Diversity using Gardner's 2 Stage DiD**

	(1) **All**	(2) **Cereals**	(3) **Pulses**	(4) **Veg**	(5) **Fruits**	(6) **Oil**	(7) **Meat**	(8) **Dry Fruits**	(9) **Milk**
Panel A: Aggregate Impact									
Post×Forest	2.190**	-0.060	-0.228	1.557***	0.426**	0.479***	-0.089	0.078	0.028
	(0.908)	(0.229)	(0.216)	(0.343)	(0.201)	(0.158)	(0.195)	(0.131)	(0.100)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
Panel B: Dynamic Impact									
2004-05×Forest	-0.754	0.082	-0.130	-0.298	-0.097	0.000	-0.153	-0.083**	-0.074
	(0.488)	(0.166)	(0.143)	(0.216)	(0.103)	(0.019)	(0.097)	(0.034)	(0.057)
2011-12×Forest	0.448	-0.296	-0.277	0.800**	0.171	0.513***	-0.182	-0.205*	-0.077
	(1.094)	(0.263)	(0.278)	(0.345)	(0.239)	(0.131)	(0.245)	(0.111)	(0.106)
2022-23×Forest	2.573**	0.198	-0.053	1.298***	0.512**	0.358**	-0.190	0.301	0.150
	(1.200)	(0.314)	(0.293)	(0.392)	(0.255)	(0.180)	(0.226)	(0.203)	(0.140)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61	

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.12: **Robustness: Impact of FRA on Source of Food using Gardner's 2 Stage DiD**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Market Purchase								
Post×Forest	-0.099	-0.408*	1.383***	0.493**	0.585***	0.211	0.018	-0.052
	(0.241)	(0.214)	(0.365)	(0.192)	(0.166)	(0.136)	(0.136)	(0.103)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel B: Home Grown and Free Collection								
Post×Forest	-0.018	0.188**	-0.066	-0.082	-0.042**	-0.248**	0.062**	0.087*
	(0.086)	(0.091)	(0.222)	(0.076)	(0.020)	(0.118)	(0.024)	(0.050)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.13: **Robustness: Impact of FRA on Dietary Diversity (Using State Level Title Distribution Data)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cereals	**Pulses**	**Veg**	**Fruits**	**Oil**	**Meat**	**Dry Fruits**	**Milk**
Panel A: Dietary Diversity								
Titles Distributed×Forest	0.570	0.125	2.906***	0.870**	1.026***	0.079	0.743**	0.255
	(0.459)	(0.467)	(0.697)	(0.407)	(0.306)	(0.410)	(0.326)	(0.215)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,571	32,571	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.428	0.477	0.374	0.245	0.529	0.450	0.426	0.397
Baseline Mean	2.24	2.30	6.80	0.94	1.06	1.35	0.21	0.61
Panel B: Source- Market Purchase								
Titles Distributed×Forest	0.695	-0.086	3.154***	1.090***	1.218***	0.797***	0.609*	0.081
	(0.487)	(0.432)	(0.822)	(0.404)	(0.313)	(0.288)	(0.337)	(0.254)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.361	0.423	0.338	0.241	0.516	0.369	0.420	0.308
Baseline Mean	1.40	1.90	5.80	0.81	1.03	1.00	0.19	0.37
Panel C: Source- Home Grown and Free Collection								
Titles Distributed×Forest	-0.260	0.228	-0.628	-0.223	-0.086**	-0.567**	0.125**	0.126
	(0.189)	(0.196)	(0.430)	(0.157)	(0.038)	(0.259)	(0.055)	(0.113)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,569	32,560	32,571	32,571	32,571	32,571	32,571	32,571
R-squared	0.294	0.239	0.225	0.159	0.088	0.194	0.106	0.227
Baseline Mean	0.59	0.36	0.84	0.19	0.03	0.30	0.02	0.23

Post is a variable that takes the value 1 for years after 2008. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.14: **Parallel Trends: Impact of FRA on Dietary Diversity**

	(1) **All**	(2) **Cereals**	(3) **Pulses**	(4) **Veg**	(5) **Fruits**	(6) **Oil**	(7) **Meat**	(8) **Dry Fruits**	(9) **Milk**
Post-2000×Forest	-1.547	0.167	-0.266	-0.612	-0.199	0.000	-0.315	-0.171**	-0.152
	(1.044)	(0.336)	(0.297)	(0.454)	(0.218)	(0.039)	(0.191)	(0.072)	(0.121)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,168	13,168	13,168	13,168	13,168	13,168	13,168	13,168	13,168
R-squared	0.509	0.407	0.495	0.431	0.277	0.238	0.482	0.417	0.421

Analysis performed using 55th (1999-2000) and 61st (2004-05) rounds of the NSS Consumer Expenditure data. *Post-2000* is a variable that takes the value 1 for 2004-05. *Forest* represents the proportion of the total area of a district that is covered by forests. *All, Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.15: **Parallel Trends: Impact of FRA on Source of Food**

	(1) **Cereals**	(2) **Pulses**	(3) **Veg**	(4) **Fruits**	(5) **Oil**	(6) **Meat**	(7) **Dry Fruits**	(8) **Milk**
Panel A: Market Purchase								
Post-2000×Forest	-0.083	-0.457	-1.090**	-0.211	0.076	0.013	-0.137*	-0.160
	(0.324)	(0.337)	(0.497)	(0.216)	(0.059)	(0.236)	(0.071)	(0.122)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,166	13,162	13,168	13,168	13,168	13,168	13,168	13,168
R-squared	0.315	0.389	0.383	0.296	0.192	0.350	0.402	0.253
Panel B: Home Grown and Free Collection								
Post-2000×Forest	0.176	0.228	0.213	-0.042	-0.031	-0.225*	-0.031	0.047
	(0.177)	(0.153)	(0.374)	(0.133)	(0.031)	(0.134)	(0.029)	(0.048)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,166	13,162	13,168	13,168	13,168	13,168	13,168	13,168
R-squared	0.340	0.287	0.335	0.217	0.117	0.250	0.167	0.282

Analysis performed using 55th (1999-2000) and 61st (2004-05) rounds of the NSS Consumer Expenditure data. *Post-2000* is a variable that takes the value 1 for 2004-05. *Forest* represents the proportion of the total area of a district that is covered by forests. *Cereals, Pulses, Veg, Fruits, Oil, Meat, Dry Fruits, Milk* represent the count of the different items a household reported consuming under each of the respective heading. *, ** and *** represent significance at .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

Table A.16: **Impact of FRA on Time Involvement of SC Women**

	(1) Making and processing food & beverages for own final use	(2) Making and processing textiles & wearing apparel for own final use	(3) Collecting firewood & water for own final use	(4) Preparing meals	(5) Serving meals
Panel A: Including District Fixed Effects					
Forest×Female	-0.008	0.001	0.263***	-0.148	0.008
	(0.015)	(0.004)	(0.064)	(0.112)	(0.162)
Controls	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes
Day of Week Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	46,852	46,852	46,852	46,852	46,852
R-squared	0.053	0.036	0.145	0.547	0.294
Panel B: Including Household Fixed Effects					
Forest×Female	-0.005	0.003	0.253***	-0.128	0.029
	(0.014)	(0.004)	(0.067)	(0.120)	(0.184)
Controls	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes
Day of Week Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	45,658	45,658	45,658	45,658	45,658
R-squared	0.449	0.335	0.432	0.663	0.480

*, ** and *** represent significance at .15, .10, .05 and .01 level respectively. Robust standard errors are reported in parentheses and are clustered at the district level.

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