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"Shifting agriculture": the changing dynamics of *Adivasi* farming in the forest-fringes of a tiger reserve in south India

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ABSTRACT

This article examines trends in farming and livelihood activities among forest-dwelling *Adivasi* farmers (Soligas) in a tiger reserve from 2008 to 2015. In-depth semistructured interviews were conducted in two contrasting, but representative, villages, where traditional mixed-crop farming was being replaced by cash crops such as coffee, maize, and cotton. Access to state-subsidized food supply and increase in cash income through wage labor, coupled with increasing depredation of food crops by wild animals, were some causes for the shift to cash crops. Declining supply of non-timber forest produce (NTFP) and the subsistence cash it provided has also impacted farmer livelihoods and indirectly contributed to this shift. The changing aspirations of younger Soligas and inadequate state support for mixed-crop farming also could be contributing factors. Soligas consistently maintained that increased wildlife depredation of food crops, reduction in supplies of wild foods, and the decline in NTFP was due to poor forest health. The transition to cash crops improved cash flows but exposed the Soligas to market risks. While food security also improved, the nutritional quality of diet declined. Soligas are adopting new farming practices, diets, and livelihood strategies, and importantly, leveraging rights historically denied to them, all a reflection of their social resilience.

KEYWORDS

Adivasis; Karnataka; livelihoods; rainfed farming; tiger reserve

Introduction

About 1.3 billion people in the world directly depend on forests, while approximately half a billion indigenous people reside in forests that are critical for their survival (Chao 2012); much of this population is concentrated in the global South, especially the Asia-Pacific region (Ma 1999). While there is considerable overlap between forest regions and areas with high levels of poverty (Sunderlin et al. 2008), for these marginalized groups, forests provide a range of goods and services that contribute significantly to their livelihoods and wellbeing (Byron and Arnold 1997).

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One of the major reasons for changes in land use and livelihoods in the forested tropics has been the conversion of forests to agricultural land, and from subsistence to commercial cultivation (Gibbs et al. 2010). Beginning as far back as the industrial revolution there was also an increase in the conversion of tropical forests to cash crop monocultures to support rapid urbanization (Williams 2006). Over time, national policies that encouraged settled agriculture—coupled with an ever-increasing demand for forest resources from global markets—have contributed to the increased rates of conversion of forests to plantation crops (Van Vliet, Mertz, and Heinimann et al. 2012). In India, there has been some conversion of forest land to agricultural use since the country's independence in 1947 (Mudappa and Shankar Raman 2012; Ravindranath, Somashekhar, and Gadgil 1997).

Subsistence farmers who grow traditional mixed crops opt for monocultures—often as a result of a range of socioeconomic drivers. Plantation crops are viewed as boom crops, bringing in higher cash incomes owing to ready markets and their low labor requirements when compared to agroforestry systems (Feintrenie, Schwarze, and Levang 2010). Growing plantation crops is also seen as a way of establishing rights over land where tenure systems are uncertain (Belsky and Siebert 2002) or influenced by migrants who prioritize cash crops over food crops (Steffan-Dewenter et al. 2007). Changing aspirations of the younger generation also leads to the move to cash crops and forest conversions (Finnis 2006).

In the Indian context, about 275 million people, comprising nearly 27% of the country's population, depend on forests for their subsistence or livelihoods (World Bank 2006). Of these, around 89 million people belong to the marginalized communities known as *Adivasis* or Scheduled Tribes (official designation given to the historically disadvantaged indigenous groups). These Adivasis have close economic, social, and cultural links to forests: They access forests for cultural rites and rituals, for non-timber forest products (NTFP), fodder, fuelwood, food, medicines, and wood for household and agricultural use. Shifting cultivation in the past and more recently settled agriculture have been important sources of subsistence for these communities.

Although trends and impacts of mainstream agriculture on livelihoods are well studied in India, less is known about how Adivasi agriculture is changing and how these communities are adapting to these changes. In addition, the plight of these marginalized communities inhabiting forests is rarely the focus of research, as conservation of wildlife garners most of the attention. We had an opportunity to gain a deeper understanding of agrarian change among forest-dwelling Adivasi farmers located within a protected tiger reserve. The period of investigation from 2008 to 2015 provided an opportunity to look at agricultural dynamics as a part of the livelihood strategies of the Adivasi community in the face of forest decline and changing legal and

policy regimes. Fortuitously, the period coincided with the implementation of the historic Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Rights) Act 2006 (FRA) and the transition of the wildlife sanctuary to a tiger reserve. Understanding how and under what conditions these forest-dependent communities cope with change could provide insights on how the democratic state could strengthen social resilience of these communities. Insights gained may help community leaders plan developmental interventions that improve livelihoods, reduce migration, and enable the wellbeing of these traditional communities.

Methodology

This research specifically examines the changes in farming and associated livelihood activities among the Soligas, an Adivasi community residing in the Biligiri Rangaswamy Temple Tiger Reserve (BRT), a protected area in the state of Karnataka in India. The Soligas are the only indigenous community living in this reserve. The focus of this article is to understand the dynamics of the shift from traditional mixed cropping to plantation crop monoculture and the consequences for the Soligas. These changes are examined in the light of changes to the forest ecology and the Soliga's dependence on NTFP.

BRT, situated in Chamrajanagar District in Karnataka, was designated as a wildlife sanctuary in 1974, covering an area of 324.4 km^2 (GoK 1974), which was increased to 539.52 km^2 in 1987 (Kathayat 2014). The sanctuary with its different vegetation types (Ramesh 1989) has a rich biodiversity (Ganeshaiah and Shaanker 1998), including the tiger (*Panthera tigris*) and elephant (*Elephas maximus*). The average annual rainfall in the region is 1,200 mm. In 2011, BRT was declared a tiger reserve with 359.10 km^2 of the sanctuary demarcated as a "critical tiger habitat" and 215.72 km^2 as buffer (GoK 2011). This tiger reserve declaration increased restrictions on development within the reserve area, reduced government services to that area, and brought pressure on Soligas to relocate from the core area (pressure mitigated by the FRA).

The Soligas live in *podus* (villages) on the hill slopes of BRT and the Malai Mahadeshwara Hills, while a few thousand of them also live in the plains. Podus are what the Soligas call their villages. The term "settlements" refers to podus after the government banned shifting agriculture in 1974 and forced Soligas to settle in specific locations. Around 61 podus of Soligas with a total population of 12,500 reside in BRT (Madegowda and Rao 2013). Keredimbha and Purani are the two contrasting study sites, both of which fall within the core area of the tiger reserve (Figure 1).

Over a period from 2008 to 2015, Soliga respondents were interviewed from the two contrasting sites with differing rainfall regimes and elevations: Keredimbha in the forest interior and Purani in the fringes. In addition to

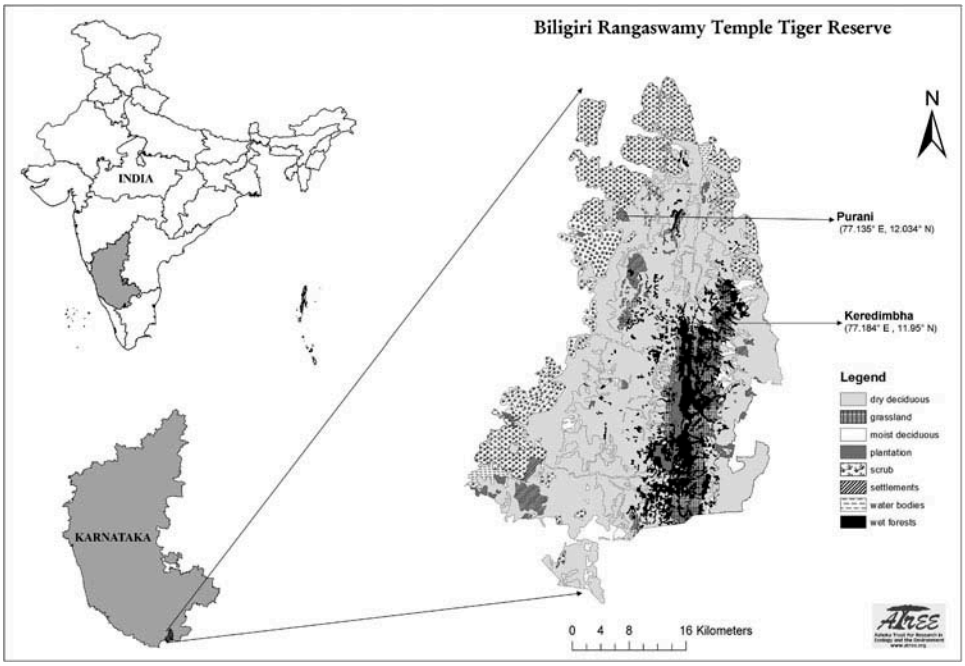

Figure 1. Location of study sites in BRT.

differing geographies, these settlements also represented differences in land tenure, agricultural practices, livelihood strategies, connectivity to markets, and access to NTFP. All the Soliga villages are distributed either in the lower elevation in dry deciduous forests or in the higher elevation moist to wet forests. Coffee is grown predominantly in the higher elevation wetter areas of the sanctuary. Villages in the dry areas grow cotton or maize as a cash crop of choice instead of coffee. The two selected villages largely represent the bimodal variability among villages in the sanctuary. Keredimbha podu is situated in the midst of a wet forest (altitude 1,300 m, with annual rainfall 1,500 mm) (Figure 2); it can be accessed by way of a dirt road only. The land in the podu slopes mildly and the soil is a sandy loam. The only perennial sources of water for household needs are an open well and a borewell that was sunk in 2014. With a few exceptions all households had solar power for lighting. The Soliga households had been cultivating on forest land owned by the government, but with the implementation of the FRA in 2009 they have received title deeds for lands they cultivated. From as far back as 1846, families from various podus in BRT settled in Keredimbha (ATREE 2006), and in 2008 there were 24 families residing in the podu, which increased to 35 by 2015. There was no increase in land available in the same period.

Purani podu, at an altitude of 700 m with annual rainfall of 900 mm has dry deciduous woodlands (Figure 3). Four small streams flow though the settlement but are usually dry in the summer months. Soil type is sandy loam

Figure 2. Keredimbha situated in a wet forest.

Figure 3. Purani located in dry deciduous forest.

in the agricultural fields with the land sloping mildly. Borewells sunk by the government are the main source of drinking water. Solar power for lighting for all households and common areas has been provided, but the access to the podu is still by means of a dirt road. In 2012, there were 115 families residing here, of which 65 owned land while the others were landless (ATREE 2006). Like in Keredimbha, the number of households has increased with older adult children setting up separate families but again within the physical boundary of the podu.

This study was conducted over three time periods. The first phase was between June and November 2008 with multiple visits made to the two podus. The follow up visits were done in April 2012 and in April 2015. The

baseline survey done by ATREE (2006) was used to identify interviewees who were selected based on land holding size and the income earned from agriculture that included coffee in the case of Keredimbha. Interviewees included those who had very small parcels of land (0.1 ha) to larger sized holdings (1.4 ha), and also those who earned different levels of income from similar sizes of land holdings. In the first round, a total of nine Soliga households, five from Keredimbha, and four from Purani, were interviewed through in-depth semi-structured questionnaires that covered farming practices, allied livelihood activities, dependence on forests, daily wage labor, government schemes, standard of living, and attitudes to policies and laws. In 2012, in Keredimbha five interviews were conducted of whom four households had been interviewed in 2008. In the case of Purani in 2012, only one of the households from the previous visit were interviewed as others were not available. Instead we interviewed three other households to examine the changing patterns of agriculture for the podu at large. In the visit in 2015, six households from Purani were interviewed, of which two had been interviewed either in 2008 or 2012 and one of them in both the previous visits. We also had conversations with other residents of the village. In the case of Keredimbha three households were interviewed of which two had been interviewed in both 2008 and 2012.

We have adopted a phenomenological method in this research, as the objective was to provide a rich description of the lived experience of people without using at the outset itself any theories or frameworks (Finlay 2009). Thus while the sample size may be small, the idea was to generate a "thick" understanding of the lives of Soliga households by giving prominence to their experiences (Laverty 2003).

Results and discussion

We explore and analyze the changes in farming since 1970 with an emphasis on the period from 2008 to 2015, look at trends and impacts, and draw out what one might expect in the future (see Table 1 for a summary). We used agricultural income and land holding size to choose interviewees to represent the range of farming households in these villages. We did not see any distinct influence of these variables on agriculture practice, and this could have been because the range in farm size among Soligas in this study is relatively small (between 0.4 and 1.6 ha) as is the sample size of famers in this study. All these farmers would be classified as marginal small farmers with less than 2 ha land holdings.

Changing farming practices

Farming practices of the Soligas have seen several changes since the 1970s. The traditional agricultural practice was shifting cultivation that involved clearing forest land and setting litter fires to enhance soil fertility. However, with the declaration of BRT as a sanctuary in 1974, both shifting cultivation

Table 1. Trends in agriculture, livelihood, their enabling factors, and impacts from 2008 to 2015.

Activities/factors	Trend	Description	
		Keredimbha	Purani
Farming practices	Shift from food to cash crop cultivation	Complete shift to coffee cultivation; native shade trees retained in coffee plantations; very few interspersed non-native silver oak trees.	Partial shift; mix of food and cash crop cultivation widespread. Maize more preferred to cotton as cash crop.
Cash crop depredation by wild animals	Reduced	When compared to food crop, much reduced, but some risk to both coffee and cotton, but risk to maize similar to *ragi* (food crop).	
Food and nutritional security	Changed	Eat more frequently in a day. But nutritional quality has deteriorated—shift from nutritious *ragi* to rice; forest degradation has reduced supply of traditional forest foods; shift from mixed food cropping to cash crops has reduced diversity of nutritional basket. Greater dependence on PDS and market, *podus* remote location makes access difficult. Very recent free distribution of eggs, pulses and *ragi* to households through State scheme could improve nutrition.	
Rainfall	Decreased, erratic, some delay in monsoons	Rainfall perceived as reduced and erratic, while temperatures have risen impacting quantity and quality of different NTFP. Farming not much affected.	
NTFP collection	Reduced dependence	Minimal to negligible collection of gooseberry. Lichen and honey are the only NTFP being collected, but that too in reduced quantities.	
Daily wage	Increased dependence	Infrequent employment in Forest Department works, but that too is declining as use of mechanization is on the increase. Steady seasonal work at private coffee plantation. Negligible migration	Work in brick kilns and agriculture in plains. Agriculture work decreasing as mechanization has increased. Men mostly migrate seasonally to other cities for work.
Employment schemes	Ineffective	MNREGS not implemented properly; no income from this scheme	
Quality of life	Improved	Perceive an improvement in life as they are able to buy food and household goods from the market more frequently. PDS functioning fairly well so basic food security is assured. Solar lights provided for all households. Functioning borewells provide for drinking water. Lack of access to electricity, paved road connectivity, and public transportation remains an unfulfilled need.	
State of the forest	Degraded	Quality of forest ecosystem degraded because of proliferation of invasive lantana, reduced regeneration of indigenous plant species and spread of mistletoe in gooseberry an important NTFP. Soligas are unanimous that this is because of lack of frequent low-intensity fire as part of forest management practices.	
Forest access and land rights	Improved	Individual and community forest rights awarded under FRA. This has included the right of access to NTFP and recognizes their right to live in and cultivate land in their settlements within forests.	

Notes: NTFP: non-timber forest produce; MNREGS: Mahatma Gandhi Rural Employment Guarantee Scheme; PDS: public distribution system; FRA: Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Rights) Act 2006.

and the setting of litter fires were banned. The Soligas moved to settled cultivation where the same piece of land was cleaned and used for farming year after year. Agriculture continued to follow a system of multi-cropping on land owned or leased ranging in size between 0.4 and 1.6 ha, as well as in kitchen gardens (Bawa, Joseph, and Setty 2007; Madegowda 2009; Madegowda and Rao 2013). In both Keredimbha and Purani, a mixture of food crops was cultivated, including a wide variety of millets, cereals, pulses, spices, fruit, oil seed, tubers, vegetables, and leafy vegetables; this was true for both shifting and settled agriculture.

The next significant phase in farming was the adoption of coffee as a cash crop, which the Soligas began cultivating in the early 1990s, predominantly in the core area. The percentage of Soliga households in wetter areas growing coffee has grown from 40% in 2006 (Bawa, Joseph, and Setty 2007) to an estimated 80% in 2015 (pers. commun., C Madegowda, a Soliga leader, 2015). While Keredimbha, situated in BRT's core, had some families cultivating coffee since the late 1970s (ATREE 2006), the interviewees had been growing coffee since early to mid-1990s. Coffee was initially grown on a part of their agricultural land with other fruit yielding trees, while food crops and vegetables continued to be grown in the remaining portion of the land. The area under coffee was progressively increased by 2012, with some farmers still growing food crops. However, by 2015, traditional food crop cultivation was discontinued, converting the entire agricultural land into coffee cultivation. Farmers retained native shade trees necessary for coffee production while also planting more fruit trees such as guava (*Psidium guajava*), jackfruit (*Artocarpus heterophyllus*), citrus species, mango (*Mangifera indica*), and NTFP. A few farmers introduced shade trees of silver oak (*Grevelia robusta*).

In Purani, the entire land area was used for growing food crops from the 1970s until recently. Since rainfall does not support coffee, farmers later included the cultivation of maize (*Zea mays*) and cotton (*Gossypium hirsutum*) as cash crops on a part of their land. The maize variety used several decades back was indigenously bred from seed obtained from the settlement of Tibetan refugees adjacent to BRT. In the last 15 years, Soligas have been growing commercially available hybrids. However, for cotton, they exclusively use genetically modified Bt cotton. Cotton was introduced in 2011 and was taken up on a portion of land by only six farmers in the podu, influenced by relatives living in settlements on the eastern side of BRT who grow cotton. Based on the very positive inclination of farmers toward cotton in Purani in 2012, it seemed that most of the farmers would abandon maize and millets for cotton monoculture. However, in April 2015, contrary to our expectations, the number of families that had taken up cotton cultivation had not increased. On the other hand, farmers (including those who had tried growing cotton) were moving toward cultivation of maize for various reasons (discussed later). In the past, maize had been intercropped with traditional food crops for household

consumption, but the present cultivation of maize as a crop for sale, primarily to the poultry industry, involved setting aside a larger portion of land for growing it. Also, unlike in Keredimbha, some land continued to be allocated for growing food crops, mainly, *ragi* (*Eleusine coracana*).

Farming practices are dynamic and follow various trajectories in the different agroclimatic zones. Farmers in the higher elevation Keredimbha were moving toward exclusively growing coffee interspersed with several fruit-yielding trees. These farms were diverse coffee gardens with native shade trees, rather than the conventional intensive monoculture plantations with one preferred species of shade tree (silver oak). In Purani, there appears to be no trend to grow any one crop exclusively. Farmers were growing some mixture of maize, cotton and *ragi* along with red gram (*Cajanus cajan*) and other minor pulses. Among cash crops, farmers preferred maize over cotton, saying they were familiar with growing it. Although a good cotton crop generates higher returns than maize, growing cotton is labor intensive and requires pesticide inputs. Furthermore, some years the farmers bought spurious seeds that produced only vegetative growth and no flowers. While farmers in Keredimbha were not using any chemical fertilizers or pesticides on coffee plants, farmers in Purani used chemical fertilizers and were not averse to using pesticides when needed for their cash crops.

Unlike the changes in crops grown, animal husbandry practices remained stable. Livestock and poultry were grown for home use and for sale when cash was needed. Most households in Purani owned chickens, goats, sheep, or cattle, while in Keredimbha most owned only poultry. Farmers in Keredimbha mentioned that the Forest Department discouraged them from grazing livestock, but there seemed to be no felt restrictions in Purani.

Other livelihood opportunities

NTFP was an especially important cash income source for the poorer households situated in the forest core (Shaanker et al. 2004). Landed and landless Soligas depended on other livelihood opportunities such as NTFP collection and daily wage labor on a seasonal basis to supplement their meager subsistence cash income. With agricultural income sufficing only for 4–5 months a year and 40% of the Soligas still being landless (Madegowda and Rao 2013), both NTFP and wage labor contributed significantly to household incomes. Before the ban, NTFP contributed 85% of total household cash income, while wage labor contributed only 13% (Sandemose 2009). The Soligas have sole rights for harvesting NTFP from the forest but can only sell it to the tribal cooperative Large-Scale Adivasi Multi-Purpose Societies (LAMPS)—the intermediary between the Soligas and the outside buyers (Shankar et al. 1996). The Soligas in both podus said that they had collected a wide variety of NTFP in the past (both for sale and household use), walking 6–11 km into the forest. Honey

from rock bees (*Apis dorsata*), lichen, gooseberry (*Phyllanthus emblica* and *P indofischeri*), soapnut (*Acacia sinuata*), soapberry (*Sapindus laurifolius*), *shikakai* (*Acacia concinna*), and mountain date palm (*Phoenix loureiroi*) were the important NTFP collected for sale to LAMPS. The implementation of the Indian Wildlife (Protection) Amendment Act 2002, however, banned the Soligas from collecting NTFP from the wildlife sanctuary for commercial purposes. The ban—imposed in 2004 but only strictly enforced in 2006—was lifted in 2009 after implementation of the FRA. Soligas in both Purani and Keredimbha resumed collection of NTFP, primarily lichen, honey and gooseberry, but the quantity of NTFP collected and their contribution to household income has seen a reduction in recent years. While the community rights of the Soligas over NTFP were legitimized under the FRA in 2011, assuring them access to NTFP, the supply of NTFP was declining with the steady degradation of forests.

In both sites, all our respondents said that the collection and selling of gooseberry, once a significant income source (Shankar et al. 1996), had drastically reduced in recent years. The lack of traditionally managed low-intensity fires and the increase in the mistletoe parasite on the fruit-yielding trees are given as the main causes. Soligas do not see it worth their effort to collect the very limited fruits. The Soligas probably consider the opportunity costs too high for harvesting and trading gooseberries now, rather than for other NTFP like honey and lichens, which continue to attract harvesters from both podus. In Keredimbha, the collection and sale of lichen continues to provide cash income for a few months in a year, particularly in the monsoon months (June–October). In both sites, honey collection and sale is pursued by a decreasing proportion of the population, contributing negligibly to livelihoods. The younger generation is refraining from the arduous, but socially collective effort of collecting honey.

Daily wage labor continues to be an important but variable source of work throughout the year. Dependence on wage labor increased during the period of the NTFP ban in the study sites and other podus, as did the incidence of migration both within Karnataka and to nearby states (Madegowda and Rao 2013). The source of daily wages included work with the Forest Department and private coffee plantations, and employment as agricultural labor, in brick kilns, and in construction work in neighboring towns (Reddy et al. 2001; Shaanker et al. 2004). Keredimbha depended more on work in the nearby private coffee plantations and contractual labor offered by the Forest Department that involved tasks like controlling forest fires, maintaining paths and clearing weeds, though the latter as a source of employment has reduced considerably since the Forest Department increased its use of machines. With private coffee estates providing year-long employment (other than a few months during the monsoons from June–August), there was only one incidence of migration from Keredimbha to work in a coffee plantation mentioned in 2012. In Purani, the main sources of wage labor

were the brick kilns and agricultural work in nearby farms, but with the increasing mechanization of agriculture in the plains, the dependence on the latter had decreased. This resulted in increased migration to both nearby towns and distant places like Bengaluru (>100 km) and Hyderabad (>500 km). It was usually the younger generation who migrated, while the parents stayed back to take care of the house and livestock, and agriculture in the case of those who possessed land.

Forest-fringe dynamics and the shift to cash crops

Close proximity of these farms to wildlife-rich spaces protected by state mandate makes farming a challenge, and is one of the key factors driving the changes in farming practices. Podus face daily depredation from wild animals and birds that cause extensive damage to crops. The Indian wild pig (*Sus scrofa*) is considered the most destructive, causing extensive damage, but other animals like elephants, deer (primarily spotted deer, *Axis axis*), and hare (*Lepus nigricollis*) were also listed as threats. Birds were also marauders feeding on *ragi* seeds.

In the case of Keredimbha, by 2015, the problem from wildlife had resulted in farmers completely shifting from food to coffee cultivation. Farmers in Purani also mentioned that they preferred to grow cotton because it was not eaten by wildlife. In the past, the Soligas in both podus had to invest significant time and effort in guarding food crops from wild animals. The degradation of forests—represented by an increased intensity of invasive weeds such as lantana (*Lantana camara*) that has reduced the nutritive forage for wild animals—is seen as one of the main reasons for the increase in wildlife marauding food crops. Forest decline is a serious problem that can be mitigated if there is change in the perspective of the Forest Department. This is a larger topic and cannot be dealt with in detail here, but suffice it to say that an undue focus on numbers of wildlife, particularly tigers, without addressing overall forest ecosystem health is a major reason for its decline.

Cash crops are seen as important during times of environmental insecurity (Finnis 2006). The Soliga's move to cash crop cultivation could be seen as a response to a range of government policies introduced since the 1970s that have not only impacted the livelihoods of Soligas but also contributed to deterioration of the forest ecosystem. With the ban on litter fires the quality of the ecosystem has deteriorated, increasing the growth of the invasive lantana, reduced regeneration of indigenous plant species and spread of hemi-parasites in the gooseberry trees, an important NTFP for the Soligas (Madegowda 2009; Sundaram et al. 2012). The ban on NTFP and resulting loss of cash income contributed to farmers shifting to cultivation of cash crops, particularly coffee, in settlements like Keredimbha (Reddy et al. 2001). Since the lifting of the ban, the generally declining productivity of NTFP

species has meant decreased incomes in both podus. The forests around both podus used to have a large number of gooseberry trees, but over the years the number of trees and harvest from the remaining trees have both decreased, which the Soligas associate with the degradation of the forests. Honey and lichen were the only two NTFP being collected in 2015. The interviewees were also reluctant to venture into the degraded forest owing to fear of wild animals hidden in the lantana.

Climate and rainfall patterns are perceived to have changed in recent years, affecting forest-dependent sources of income. All the interviewees said that the amount of rain and rainy days from the pre-monsoon and monsoon had reduced considerably. Rainfall was also observed by them to have become irregular and erratic. These weather changes impacted the health of the forest, and concerns were expressed about the quality and quantity of NTFP. Collectors commented that the quantity of lichen production had been adversely impacted by low rainfall. Honey collecting is a skill that is fast disappearing, as the social customs undergirding these practices and the changing aspirations of youth diverge. Such a decline in traditional skills among the younger generation in BRT might be similar to trends in the neighboring Nilgiri Hills (Roy 2002). Therefore the effect of climate change on the shift toward cash crops is indirect, through the impact on forest health and NTFP yields. The decline in NTFP as a perceived effect of climate change reduces income for forest-fringe communities, leading to a greater dependence on other sources of income that include shifting to cash crops and migratory work.

Demand for cash income as a driver of change

The move toward cash-driven livelihoods could be a combination of changing aspirations, increased sense of security, risky forest access, and outside influence. In both Keredimbha and Purani a main reason for the shift was the ability to earn cash income from coffee, cotton and maize. The farmers in both sites also perceived an improvement in their lives from the past, as now they were able to buy food and household goods from the market every year; this perceived improvement is a sign of changing aspirations. This shift to cash driven economy is driven by the growing penetration of the market economy and Soligas' changing aspirations influenced by exposure to the outside world (Sandemose 2009). Cash crops are also perceived as a more secure source of income, especially in the aftermath of the NTFP ban. The ban caused considerable economic hardship for the Soligas, and also meant that products once available freely from the forest had to be purchased from the market, increasing their need for cash (Sandemose 2009). While NTFP collection for subsistence was allowed during the ban, the Soligas faced some harassment from Forest Department staff (Kalpavriksh 2007) with the strained

relations persisting after the ban was lifted. With all these changes, the Soligas were increasingly dependent on cash to buy government-subsidized food to afford medical care and to purchase other household needs. Therefore, the need to work in wage paying jobs continued to increase, leading to the changing livelihood strategies. As part of these changes, Soligas moved away from food crops to cash crops with its inherent risks.

Influence of government welfare mechanisms

The move to cash crop may also be indirectly linked to both the presence and failure of government welfare mechanisms in BRT. While the Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS) failed to provide stable cash income, the public distribution system (PDS) provided an alternative food source even as it required cash to access.

The PDS has enabled a shift to cash crop cultivation by providing a consistent supply of inexpensive food grains and oil (Finnis 2006; Venkateswaran et al. 2013). Both podus accessed the PDS for procuring household commodities like rice, pulses, jaggery, oil, salt and kerosene at subsidized rates. This relatively inexpensive availability of rice has meant that Soligas have moved away from eating iron-rich *ragi* (which was consumed twice a day) to rice (now consumed thrice a day). Since June 2012, the government has additionally started providing *ragi*, jaggery, oil, eggs and horse gram (*Macrotyloma uniflorum*) for 6 months free of cost, though in limited quantities, to all Soliga families. This assistance was provided in the rainy season to address widespread anemia among Soligas. In the absence of these subsidized and free food schemes Soligas would possibly have had to continue with food crop cultivation. The shift to cash crops and successful provision of food grains through the PDS and similar schemes appears to be interlinked.

The failure of the MNREGS is another reason for this possible shift to cash crops. With the Soligas increasingly moving toward a cash-based economy (Sandemose 2009), the MNREGS could have been another source of cash income during the summer lean months. However, due to nonpayment or delays in payment, the scheme was not being accessed very successfully by the interviewees in either podus. In this scenario, cash crops could be perceived as a more stable source of cash income.

Inadequate agricultural support systems

The traditional rain-fed agriculture of Soligas was undertaken with almost no support from the government. Seeds were transferred from one harvest to another. Interviewees in both podus mentioned that seeds of some cereals, pulses, and vegetables were sometimes accessed from the government-funded farmer cooperatives and other sources. Some of the seeds procured did not grow

very well, and were not preferred by the Soligas. They bought commercial varieties if they had the cash. With the ban on any fire on their land for fear of igniting forest fires, the farmers in Purani said they accessed urea and compost from the government to supplement the soil fertility, but the quantity supplied was insufficient to cultivate the entire agricultural land. In Keredimbha, interviewees did not access fertilizers from the government, but leaf litter, allowed to dry and rot in the fields, served as manure. Pesticides on food crops were also not used in either site. Thus the support available for food crop production was minimal in the podus either from the government or other sources.

Sometimes the provision of government support itself was misplaced. Sheep were given to farmers in Keredimbha, despite the ban on grazing. Recently, under a government scheme, an ill-adapted chicken breed was distributed in Purani, but these suffered from high mortality and poor health under the climate and nutritional conditions in the podu. On the contrary, the local breed was doing well and preferred by the Soligas. The government could consider strengthening the research and support for such local breeds rather than introducing varieties that are not adapted to these environments. For this to happen, the vision and framework for such agricultural interventions would need to change to a Soliga-driven participatory process rather than the state-driven conventional "lab-to-land" method that has had limited success throughout the world (Birner and Andersen 2007).

Government-enabled credit support for agriculture was nonexistent. Therefore, the Soligas accessed credit from informal sources for their cash crops. At Purani, the seed and fertilizer merchant advanced credit to purchase cotton seeds, pesticide, and manure for cotton; however, produce had to be sold back to these traders. The terms of this exchange were not equitable, with the traders taking advantage of the Soligas' ignorance and weak bargaining power. Thus, the Bt cotton seeds were sold to the Soligas at thrice the market price, and farmers were encouraged to spray much more pesticide than the recommended level. Seeds of both maize and cotton were sold much past their expiry dates, resulting in very poor or failed harvest. Coffee plants in Keredimbha were collected from wild seedlings, from the established commercial plantations, and limited numbers were obtained from the state-run horticultural department when the project was funded. However, the coffee crop was sold to one of two traders who advanced loans to Soliga households at a fixed price irrespective of the market price of coffee. In spite of this, the farmers were able to earn some cash income even after paying off their loans. From the traders' point of view it was a win–win situation: They were assured cheap produce from captive producers. Thus, the near absence of government support for traditional rainfed farming and the availability of credit from informal, but reliable sources could be an enabling factor for the shift to cash crop cultivation.

Coping strategies to wildlife and climate risks

The threat from increasing wildlife depredation seems to have decreased in the case of cash crops like coffee and cotton (but not maize), encouraging the move toward growing these generally wildlife-safe crops. In the case of the shift to maize from cotton in Purani, the Soligas have calculated that the risks of protection of maize and food crops like *ragi* against wild animals are much less than the risk of a failed cotton harvest. However, even cash crops are at risk of wildlife depredation, which is associated with increasing wildlife numbers, their adaptive behavior to changing food sources, and decreasing forage in the forests. Elephants browse on native shade trees in coffee plantations, (Kumar, Mudappa, and Shankar 2010), while some elephants are also developing a taste for ripe coffee berries in this region (Bal et al. 2011). However, the Soligas continued to depend on a diversity of livelihood sources over both space and time, therefore mitigating these potential risks. Human-wildlife conflicts in forested areas will continue to exist, if not increase and are wicked problems; it is unlikely that a single strategy for mitigation will work, but instead a range of policy- and farmer-driven measures is required (Bal et al. 2011).

Climate-change–induced direct threats to coffee or cotton farming in BRT are minimal to nonexistent. These crops are sensitive to temperature and rainfall, which determine both yields and attack by insect pests. Models for climate change in coffee growing areas of Mesoamerica, a site that is comparable to BRT, have indicated that climate change can adversely impact livelihoods requiring locally suited adaptation strategies and government support (Baca, Läderach, et al. 2014). Some impacts have already been felt closer to BRT. In 2009 and 2010, coffee production in Karnataka, the state where the study sites are located, had seen reduced yields as a result of irregular rainfall (IANS 2010) and attack by insect pests, owing to a dry spell (Prabhu 2014). The interviewees in Keredimbha commented about the reduced and irregular rainfall in recent years. While there is no perceived impact on coffee yields, the models for future impacts should serve as a caution. Mitigation is critical, and options should be examined in manner that will contribute to livelihoods of the Soligas. For example, use of shade trees in coffee cultivation has an important role to play in maintaining a suitable microclimate for the crop (Lin 2007). Many of the Soliga coffee farms are interspersed with trees. Encouraging a careful choice of species can ensure maintenance of suitable microclimate as well as meeting household needs of fruits and fuelwood while increasing the diversity of agroforest species. With the Soliga households in Purani moving away from cotton, the impact of climate vagaries on cotton cultivation are not a major concern. Further, maize has been traditionally cultivated in Purani, and has been suited to the climate. However, with predictions of unfavorable climate in the future, the resilience of the Soligas will be tested, perhaps more than ever before.

Livelihood risks and mitigation strategies

The shift to cash crop cultivation brings with it concerns of market volatility, indebtedness, and extreme social distress resulting in suicides. Steep and unpredictable fluctuation in prices, exacerbated by adverse climatic conditions, can lead to a boom and bust cycle that impacts low-income rainfed farmers. Small coffee farmers in other parts of India have suffered financial hardship as a result of volatility in global coffee prices. In Keredimbha—where Soliga households have completely shifted to coffee cultivation—market volatility could be cause of concern. However, none of the interviewees mentioned any significant impact of the fluctuation of global coffee prices on their sale value the last 20 years of growing coffee. The availability of credit from the local traders, and a low but consistent price for their coffee buffered any market volatility.

Credit for coffee and cotton were provided by traders, but the Soligas had to sell their produce back to these traders at the price quoted by the latter. This credit system often works to the advantage of the traders and undermines incomes of Soligas; but this has not yet resulted in indebtedness. Further, the traders who procure coffee from the Soligas in Keredimbha have been paying a fixed price for coffee irrespective of market rates, even when prices were low. In the future, Soligas may not have any alternatives to fall back on, but continue to grow cash crops supported by the credit provided by the traders.

The diversified livelihood strategy of Soligas is a means of mitigating the risks of pursuing a single and vulnerable livelihood activity such as growing only cash crops. NTFP collection, daily wage labor by some or all family members, food and cash crop cultivation all add to this diversified livelihood strategy. With increasing political solidarity and activism among Soligas as a community, their capacity to maintain and enhance their access to government welfare schemes further helps mitigate risks. Soliga farmers continue to grow kitchen gardens and the fields of coffee growers are interspersed with a variety of fruit trees, including five species of citrus. A majority of coffee growers across the world are small holders who grow coffee on 10 ha or much less. Retaining diversity in their farms by growing food crops, fruit trees and keeping livestock has been able to provide for basic needs of households in the case of smallholder coffee farmers in the Mesoamerican region (Mendez et al. 2010; Caswell et al. 2014; Jha et al. 2011). Diversifying livelihood strategies and retaining diversity in their farms can help reduce vulnerability of the Soliga farmers. However, the future still remains uncertain with unpredictable climate change, increasing exposure to market risks, and changing aspirations of the younger generation.

Consequences on food and nutritional security

For subsistence farmers, the commercialization of agriculture that includes substituting food crop cultivation with cash crop cultivation could adversely

impact their nutritional security, even while providing the cash to secure food at both subsidized and market rates. Thus, while cultivation of cash crops like coffee can reduce the 'lean months' (Baca, Liebig, et al. 2014), food security and an impoverished diet can persist as a major cause for concern (Morris, Mendez, and Olson 2013). In the past, food crops grown by Soligas in the study sites were able to meet household needs for only about 5–8 months. Interviewees in 2008 said that they had to eat in a controlled manner if they wanted to stretch their resources for the whole year. In 2012 and 2015, interviewees expressed an improvement in their lives, as they were then able to eat three meals instead of two. Apparently, the money earned from cash crops, coupled with improved PDS has contributed to their ability to purchase food and goods from government outlets and the open market, and stave off hunger. In contrast, the nutritional quality of their food intake decreased for a variety of reasons. First, in both podus the move to cash crops has directly reduced the availability of nutritious food under the traditional mixed-cropping system. Maize was once a food crop in Purani, but the variety grown today as a cash crop was not preferred for consumption. Second, Soligas traditionally supplemented their food crops with nutritionally rich wild edible leaves, roots, tubers, mushrooms, spices, fruits, and honey from the forest. In recent years, they feel it has become harder to collect such food, owing to the degradation of the forest, especially increased lantana growth. Third, the variety of food available at the PDS is limited, and one of the main items purchased is polished rice. Polished rice, though consumed thrice a day, has replaced the nutritionally rich *ragi* (an excellent source of iron) and other traditional homegrown pulses, cereals, and millets (Shobana et al. 2013). Access to polished rice, coupled with poor supply of traditional crops and wild foods, adversely affects their diet and nutritional security.

These small farmers who grow cash crops show increased dependence on government welfare schemes and the open market to meet their food needs. This increased dependence on government welfare schemes for basic food has contingent risks (as seen in the sudden discontinuance of PDS delivery to Purani), but it is perhaps mitigated by the democratic nature of government where local representatives are accountable in some measure to the people. The debate on welfare politics and the direct public investments in food security of the poor is a much larger topic that cannot be discussed here in detail other than to indicate its relevance to this vexing, wicked problem of food insecurity.

For the Soligas, food availability on a daily basis through the year is a challenge and prone to risk. The subsidy under the PDS and free rations under the recently launched nutrition program provide insufficient quantities to meet the family needs for the entire year; the shortfall has to be met by purchasing from the market. The increasing shift to rice consumption

requires that the farmers generate cash to obtain it, as they do not grow rice. This phenomenon of a dietary shift bringing about increased dependence on cash crops has been reported elsewhere too (Venkateswaran et al. 2013). Cash income would allow improved purchase in the markets, but both Purani and Keredimbha are situated at a considerable distance (8 to 10 km) from the nearest paved road, making access to markets difficult and forcing families to incur relatively high transaction costs. Thus, increased income does not necessarily improve food security, since the availability of food and access to it are a challenge. In 2015, it was reported that the delivery of PDS to Purani had been disrupted and the Soligas now had to access the PDS outlet located 8 km away. Again prices of food bought from the market are subject to fluctuations, and farmers who have moved from subsistence to cash crops face increased vulnerabilities and levels of stress (Anderman et al 2014; Kanyamurwa et al. 2013).

The choice of Soliga farmers to move from food to cash crop may be viewed as either a coping mechanism or as a change motivated by the changing aspirations of the youth in a globalizing world. Eating nutritious food becomes less of a priority when compared to purchase of items like cell phones, clothes, and jewelry (Finnis 2006). The "luxury" of being able to purchase new clothes more often and discard old ones is a sign of these aspirations. As one of the interviewees expressed, it was possible for them to buy more new clothes, and more often now than before. Members of the younger generation also express reluctance to consume food from the forest, perhaps, considering consumption of traditional foods as a sign of "backwardness" (Venkateswaran et al. 2013). How to meet both the aspirational and food (and nutritional) security needs, thus, becomes a growing challenge. Cash crops might have the advantage of generating higher incomes for Soliga farmers, but at the cost of a lower level of control over their own food supplies.

The resilient Soliga farmer

The future wellbeing and solidarity of the Soliga family is contingent on their resilience as a community to the vagaries of climate and markets, their response to the changing aspirations of the younger generation, and how they negotiate the political topography of living within a tiger reserve. Adger (2000) defines social resilience as "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change" (347). The resilience of resource dependent communities like the Soligas is affected by external decisions (such as policy decisions of the state with regard to resource use) or events (such as adverse climate) (Adger 2000). The nature of and access to institutions, formal and informal, become important factors in building social resilience (Adger 2000).

In spite of structural changes beyond their control, the Soliga farmers have shown a remarkable degree of social resilience. The ingenious Soliga farmers in BRT including both the podus have not just bounced back or coped with change, but appear to have displayed "transformability," or the ability to creatively develop an alternate system of livelihoods (Folke et al. 2010; Keck and Sakdapolrak 2013) when political decisions detrimental to their interests were imposed upon them.

The declaration of BRT as a sanctuary and the ensuing restrictions on shifting cultivation, hunting, and grazing, as well as the brief ban on collecting NTFP, required that the farmers adapt their livelihood practices without government assistance. The shift to settled cultivation and the shift to cash crops to mitigate wildlife-driven losses reflect their degree of resilience. Local daily wage labor, or migratory wage labor, and access to forest-based NTFP provided a fall back option for the Soliga farming household. The adaptations need to be seen as a process of informed decision-making by small farmers to cope with environmental insecurity and to take advantage of economic opportunities. One of the interviewees in Keredimbha illustrated this point by saying that he would restart growing food crops if the others in the village did as well; he said it was easier to protect against wild animals collectively than alone.

The declaration of a wildlife sanctuary as a tiger reserve provided for greater protection of tiger habitat with the creation of core and buffer regions, tighter restrictions on human use and increased investment of government funds for voluntary relocation of people and for better management. While human residence and activity were always restricted in sanctuaries, the declaration as a tiger reserve made the core areas inviolate zones where human habitation and extraction of resources was prohibited. Those residing in core areas were provided limited funds to resettle, and often the government tacitly made it difficult for communities to reside in core areas by denying them access to legitimate government services. However, the FRA provided protection against relocation of Adivasis residing in these areas, and gave them conditional nontransferable ownership rights to land they were traditionally cultivating, and traditional usufruct rights. The Soligas have so far as a group resisted the compensation and rehabilitation packages that have been provided to encourage them to move out of the tiger reserve. They consider the present tiger reserve as their homeland with ancestral burial and sacred sites spread throughout the reserve. The implementation of the FRA in the Soligas' favor and their access to a range of institutions in the informal and formal space has positively contributed to Soliga capacities for resilience. For example, many of them have been able to access government help for building brick and cement houses, which they consider an improvement in their living standard. While legislation and administrative decisions over the years have often been detrimental to the Soligas' way of life and their

interests, the enactment of the FRA has provided the opportunity for greater control over their land and forest resources. Prior to the Act, only a small number of Soliga farmers had owned their land. Under the FRA settlement, individual rights to land are being processed. Additionally under the FRA and in the year 2011, BRT became the first protected area where community forest rights were granted (Pallavi 2013). Soligas could now securely access their sacred and cultural sites as well as collect NTFP. This could also enable the future provision of basic facilities like paved roads and electricity that interviewees in both podus expressed as the most important needs of the community today. The Soligas have participated with local NGOs for more than a decade to come together and organize for ecological monitoring (Setty et al. 2008) and later for securing rights to forests. In addition to their informal structures at the village level, they have been able to work with a range of formal institutions that include the state entities and NGOs, in activities that enhanced livelihood and strengthened their capacities (Bawa, Joseph, and Setty 2007).

The resilience of the Soliga is reflected in the way they have coped with so many changes and challenges. For instance with the ban on shifting agriculture, hunting, grazing, and NTFP collection the Soligas could have slid into abject poverty as they would have been dependent solely on the food crops that were also destroyed extensively by wild animals. But, through this turbulence, they have adapted and survived. When shifting was banned they turned to settled agriculture, when NTFP collection was banned they supplemented with wage labor, when food crops were destroyed they turned to cash crops, when one cash crop failed they shifted to another cash crop (cotton to maize). In their perception, their lives now are better as they have more to eat. If they sense the markets will let them down they are ready to go back to food crop cultivation. Their survival has been the result of their ability to adapt continuously. Further by securing their rights to hold land in forests, access forest resources and manage forests their resilience is strengthened. The FRA also protects against forcible relocation from the tiger reserve.

In conclusion, the landmark FRA ensuring secure tenure to their traditional lands, a working government welfare system, coupled with their ability to access institutions and organize politically have allowed for high degrees of Soliga resilience—this in spite of changing climate, lack of market access and increasing wildlife depredation. It would seem that the Soligas are becoming more vulnerable, but we argue that in a modern democratic state such dependencies are a right of every citizen and not a reflection of vulnerability. The capacity of marginal groups to acquire rights due to them is a reflection of their social resilience. The extent to which these communities remain resilient in the face of these mounting obstacles to wellbeing and livelihood security could be a combination of effective state-sponsored welfare services, and improved support systems for indigenous practices such as mixed-cropping systems rather than

solely monoculture plantations. It would definitely take appropriate structural changes, effective institutions and more than individual capabilities alone to build for resilience in such vulnerable indigenous communities.

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