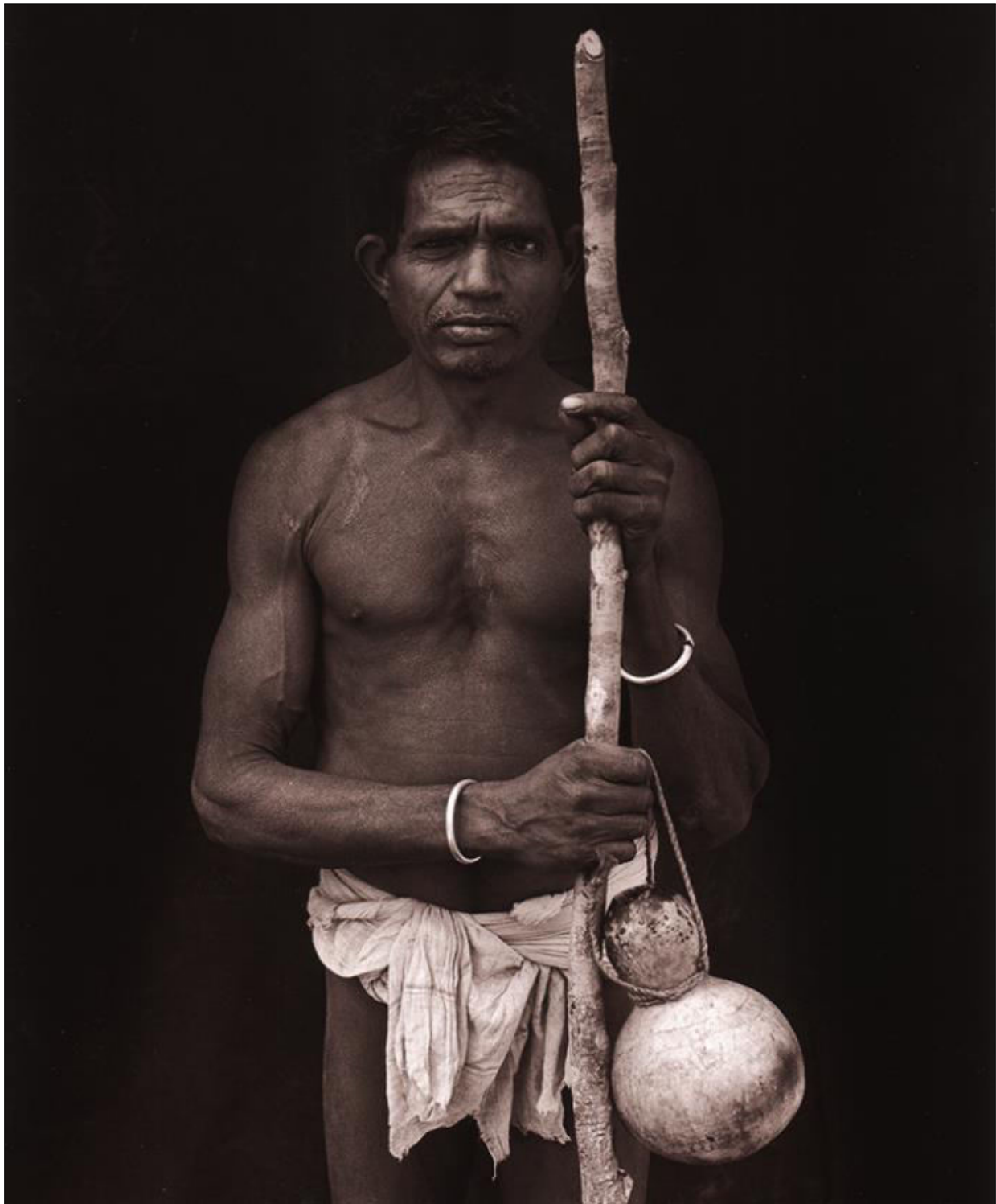

FOOD INSECURITY AND COPING STRATEGIES IN THE ABUJHMAR, INDIA: THE FACE OF MARIA TRIBE.

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Mahua (*Madhuca indica* Gmel) is common in the Abujhmar hills, where consequently Mahua spirit is distilled or drunk, where it does occur, the Marias collect its flowers and fruits eagerly.



The bodies are usually well developed, and the easy, upright carriage of the Maria displays to advantage his good chest, buttocks and calves.

*The cloud comes from unconscious,
And still returns to unconscious.
Unconscious is nowhere to be found:
Don't seek where unconscious is.*

— Wang An-Shih
Poet-scholar-statesman under
Emperor Shen Tsung

Keywords: Abujhmar ; Maria;
food insecurity; coping strategies..
smallholder; farm.

ABSTRACT:

The Abujhmar region of Bastar, India is suffering from geographical isolation of extreme degree because of their almost stagnant population, low literacy, use of primitive technology and poverty. Being identified as primitive Tribe, the whole life of Maria tribe is primarily directed towards the raising of food from the earth, either by cultivation or by gathering the fruits of the forest or by fishing, hunting or trapping. Famine has never been a problem in Abujhmar. Food Insecurity is prevailing among Maria Tribe. It is an outcome of inadequate or uncertain access to an acceptable amount and quality of healthy food. The major determinants of diversification are seasonality, risks, labour markets, credit markets, asset strategies and coping strategies. People residing in draught prone areas acquire, overtime, an ability to deal with food shortages and loss of income and the complex methods for tackling hardships and preservative assets which are needed to sustain a living in the future usually fall under the broad category of 'coping strategies'. The present study analyzed the food security status of Maria Tribe and its determinant factors, vulnerability to food security and coping strategies. Data were collected from Maria households in the Abujhmar. Descriptive statistics and probits model were the analytical tools employed. Besides the value at risk approach was used to analyze food insecurity in the Abujhmar. For the probit model the food security status of Marias was calculated using the calorie intake method. The descriptive statistic result indicates that there is high rate of food insecurity in the Abujhmar.

Introduction

The Abujhmar, probably the least known part of India, constitutes the southwest part of Bastar division of Chhattisgarh State (Fig: 1). The Abujhmar is situated between latitude 18°28' 53" and 20° 2' N and longitude 80° 37' and 81° 36' E and spread over about 3,905 Sq.Km. In the absence of any survey, the exact boundaries and area of the Abujhmar is difficult to ascertain. (Fig: 2). the term 'Abujhmar' is a mixture of Hindi and Gondi (Languages of India). The Hindi word being Abujh meaning 'misterious' or unknown and 'Marh' meaning jungle, forest or hills. Abujhmar is a tract, which is still aboriginal and the light of education, modern culture and health services has not reached the area, which is yet beyond the ken of the revenue Department of Government. Due to poor line of communication, high hills and deep valleys, relative in accessibility, prevalent wild animals in the forest, and moreover due to Naxalites activities. The Abujhmar has remained cut-off from the outer world and largely undisturbed. The confused mass of Abujhmar forms independent natural division in the physiography of Bastar. The Abujhmar is rightly described as a tangled knot of mountains. The mountains of Abujhmar do not confirm to any regular feature but there are hills and valleys in all directions. It is this configuration of mountains and valleys that make Abujhmar so difficult to penetrate. The peaks of Abujhmar Mountains vary in height from 2050 feet on the northern fringe to 3322 feet. There are in all 14 peaks which exceed 3000 feet in height. The Abujhmar is most sparsely peopled tract of India. The Abujhmar area has population density of less than 10 persons per square mile, and total population of 34,000 Maria inhabits 233 villages. This remains a land of savages seeking still for human victims to sacrifice to their fetishes, skilled in herbs and simple and potent practitioners of magic and witchcraft. Generally one can understand Marias is naked savages, living on roots and springs and hunting for strangers to sacrifice. The Marias of the Abujhmar hill seems to be the most primitive and isolated 'aboriginal' race of India.

Procuring of Food

The whole life of Maria is primarily directed towards raising of food from the earth either by cultivation or by gathering the fruits of the forest or by fishing, hunting or trapping. This agriculture as we have seen determines the sites of his villages and regulates his relations with his wife. The Marias still regards the crops as the result of the combined labour of the village rather than of the labour of individuals. If one suffers, all suffer and all combined to support the old and the needy and to help each fellow villager to get through the heaviest parts of the yearly agricultural round. The young man on marriage or the fellow clansman setting in the village must have the share of his village lands for cultivation. In the raising of crops, then the villagers and not the individual cultivator is the unit, even now in the Abujhmar hills. Some has long begun to practice the more advanced methods of the settled cultivation. Permanent rice fields are definitely the private property of Individuals; and as the use of the plough spreads and more and more of the wet lands become permanent rice fields. The owners of these fields begin more and more to assert in their shifting cultivation plots the right of permanent private ownership already admitted in their fields. This has happened among the Marias, aided by the rapid growth of population increasing the pressure on the land and reducing the land available for distribution to newcomer to the villages. The term generally used is penda for shifting cultivation.



Figure: 1 Chhattisgarh in India map

Life style of Marias

Many tribal families depend on forest produce for one meal and for second one on agricultural produce throughout the year. The capacity of the Marias is very limited to purchase of any edible items or otherwise. In order to purchase petty things like oil, sugar and salt, tribals had to sell: (1) a portion of the rice (2) forest woods (3) Mahua (*Madhuca indica* Gmel) and honey gathered from the forest. This indicated the extent of purchasing power and economic conditions. In this connection, not even a single respondent had

Significance

We collated a unique dataset covering land use and production data of 267 households in 93 sites in 17 villages across the Abujhmar. The study quantifies the importance of off-farm income and market conditions across sites differing strongly in agroecology and derives generally applicable threshold values that determine whether households have enough food available to feed their families. These results show there is a strong need for multisectoral policy harmonization and incentives and improved interconnectedness of people to villages centers and diversification of employment sources, rather than a singular focus on agricultural development of smallholder cultivator in the Abujhmar, India.

admitted that they could afford to buy the basic essentials such as cereals or pulses or vegetables even when they had nothing to eat by money they are fully depends upon the barter system in which they purchase any thing by exchanging their forest materials collected by them. The routine dietary intake of the Marias is alike and their life style including associated beliefs in near and far villages were not different. The routine diet remains more or less same and slightly affected by the change of season. Though the concept of socially impressive and nourishing food is widespread up till now their consumptions are subject to the availability and linked with their economic condition. Most prevalent method of cooking adopted by tribes is boiling and roasting practices followed by fermentation and at this point they least use fuel and advocates the energy saving techniques as they make their food once in a day and limited only to boil the rice neither chapattis nor pulses are part of their food which consume maximum fuel.



Figure: 2 Location of Abujhmar and chhatisgarh

Food Insecurity

Achieving sustainable food security (i.e., the basic right of people to produce and/or purchase the food they need, without harming the social and biophysical environment) is a major challenge in a world of rapid human population growth and large-scale changes in economic development (Foley, J.A. 2011). In the Abujhmar, production on smallholder is critical to the food security of the poor Marias, and

contributes the majority of food production at the local level. National policies and local interventions have profound impacts on the opportunities and constraints that affect smallholders (Dorward, A.R. 2003). However, policy frameworks that aim to improve food security and rural livelihoods in the developing world face many uncertainties and often fail (Ericksen, P. J. Ingram, J.S.I. Liverman, D.M. 2009).

The formulation of effective policies needs adequate information on how different options affect the complex issues surrounding food security and sustainable development. A complication in generating such information is the large diversity within and among small holders cultivation systems. Agro ecological conditions, markets, and local cultures determine land use patterns and agricultural management across regions, whereas within a given region, households differ in many ways, including resource endowment, production orientation and objectives, ethnicity, education, past experience, management skills, and in the households' attitude toward risk. Policies by their nature have to be widely applicable, but recognizing this diversity in households is key to designing more effective policies to help poor cultivators (Giller, K.E. 2013). Understanding the main drivers of household diversity and their relationship with livelihood strategies can help to better codesign and target agricultural innovations (Klapwijk, L. van Wijk, M.T. van Asten, P. Thornton, P.K. Giller, K.E. 2014).

In this study, we brought together cross-sectional household characterization data from 93 sites in 17 villages (Fig. 3). Such a large database provides an immensely rich resource to derive descriptions linking indicators of food security and land use to the socioeconomic and biophysical Environment of the smallholder.



Figure: 3. Map of the study sites in the Abujhmar, places are represents the number of households surveyed.

We use these data to develop a simple household performance indicator (Fig. 4) that is robust and can be calculated based on the household information collected in different surveys. We hypothesized that a few simple but important household characteristics can be used to tease apart the large diversity in households and cultivating systems, thereby leading to an improved understanding of the main drivers of the complexity in household functioning and that these characteristics can be used predictively to inform policy options.

Results

The Dynamics of Food Availability.

The importance of different household activities changed from households with insufficient food available to those households with ample food available across the whole dataset (Fig. 5 A and B). Households that had insufficient food available obtained their energy mainly from the consumption of food crops produced on-barren land.

By contrast, households with more adequate food availability (FA) depended more on cash-generating activities, although consumption of self-produced food crops still provided the base supply of energy. Consumption of self-produced food crops did not cover the food need for almost 80% of the households. Crop and livestock product sales were a substantial part of the FA indicator [expressed in potential food equivalent (PFE) energy (kcal) per capita per day] for these households, suggesting that the majority of households do not aim for full food self-sufficiency. Most households have a PFE value larger than the household's daily energy requirement (Fig: 5A), but it is important to note that the FA indicator is an indicator of potential supply (i.e., it overestimates actual FA). However, despite all of the assumptions, the FA indicator is a meaningful indicator for food security: the indicator is strongly correlated with self-scoring of food security status of food security status, household level diet diversity, and Hunger and Food Insecurity Status indicator.

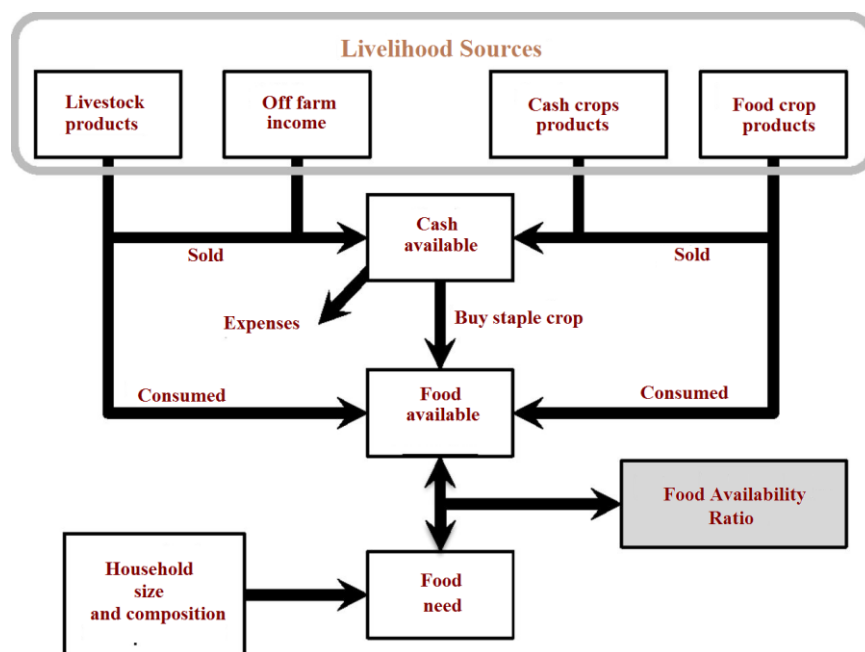


Figure: 4. Schematic representation of the calculation of the FA at household level in energy (kcal) per capita and per day (Romain Frelat et al 2016).

Overall, off- cultivation income was more important for households with higher FA: its importance as source of PFE energy increased from 12% for households with insufficient food to 27% for households with potentially more than enough food (Fig: 5B). The main intensification pathway was cash crop production, with an increasing relative importance from 4% for the households with insufficient food available to 11% in the sufficient food-available households. Across the three FA classes, the contribution of livestock to PFE was relatively conservative with a total contribution of about 20% (Fig: 5B). Within this overall contribution of livestock, though, there was a clear shift away from poultry to cattle as the level of FA increased. The contribution of food crop consumption decreased from 45% for the households with insufficient food available to 22% in the more than sufficient food-available households. The sale of food crops was stable at roughly 20%. Crop production was the major source of PFE energy, providing

from 67% for the insufficient food-available households to only 55% for the households with more than sufficient food available.

Food-Availability Thresholds and Constraints.

Land, livestock, and household size explained a substantial part of FA variation (R^2 of 0.33; Fig. 6 D). The response curves identified by the artificial neural networks (ANNs) (these were used because they do not use a predefined response relationship and can fit highly nonlinear relationships) were robust (i.e., they had a small uncertainty). The relation between land used for cropping and FA was a nonlinear saturation curve, with a threshold at around 3 ha (Fig. 6A). This finding suggests that land productivity decreased in households with more land. FA without off- cultivation income increased gradually with increasing livestock ownership (Fig. 6B), although two rates of change in the response were visible: at the Marias livestock unit (MLU) values below 0.2 (two goats or 20 chickens), there was a strong increase in FA per unit of increase in MLU, whereas for MLU values larger than 0.2 the slope was less steep. The FA—household size response was as expected (i.e., FA decreased as family size increased, but the overall response was flatter than the expected reciprocal relationship which is used in the calculations).

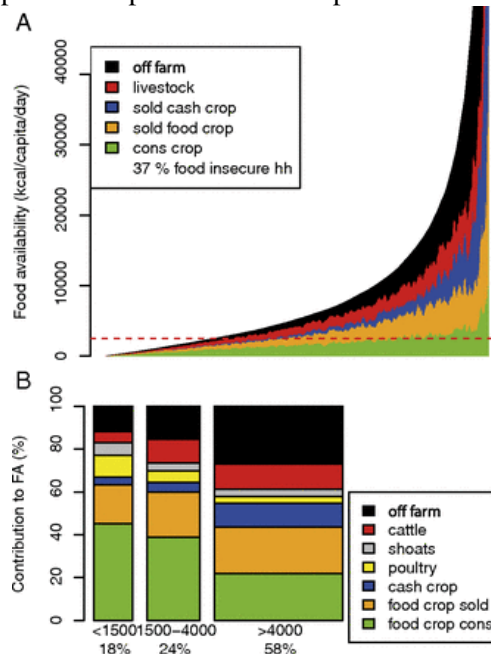


Figure: 5. (A) Overall distribution of food available (FA) in energy per capita per day for the 267 households. Households are ordered on the x axis based on increasing FA. Each vertical bar represents one household, the colors represent its sources of energy, and the height represents the degree of FA. The red dashed line is a PFE of 2,500 kcal per capita per day, the daily energy need of a male adult (36). For the ease of interpretation, a moving average has been applied with a window length of 100 households (to smooth the curves). (B) Relative contribution of household activities to FA per FA class (not enough food available <1,500 kcal per capita per day, roughly enough food available between 1,500 and 4,000 kcal per capita per day and more than enough food available >4,000 kcal per capita per day).

The ANN response model with the three primary household resources was used to predict the FA “frontier” (Fig.7). Based on the resources of the household and its size (crop land, livestock, and family size), the model predicted correctly the FA status (can a household, yes or no, produce and/or purchase enough food to feed the family?) of 72% of the households (with a PFE energy threshold set at 2,500 kcal per capita per day). We considered model performance to be satisfactory, given the fact that the FA status indicator is a binary variable with high levels of associated noise (with many households, close to the threshold value; Fig. 5A). Increasing family size shifted the livestock—land threshold curve upwards, so more land and livestock were needed to feed the family (Fig: 7). This simple model had a relatively good

prediction power with an α error of 0.25 (probability erroneously to predict a household to have enough food available to feed the family) and a β error of 0.35 (probability erroneously to predict a household as having insufficient food available).

The frontier curves shifted substantially when the environmental factors were taken into account (Fig: 8). in land but not market constrained systems (populated and more land intensive central Abujhmar, "L"), the land threshold was smaller (i.e., cultivators were food secure with less land than predicted by the overall model of Fig: 7). With around 0.4 ha, a family of 4.4 male adult equivalents (MAEs) was predicted to be able to produce enough food and cash to feed the family. Households in market-constrained environments ("M," "LM") needed more land to achieve sufficient FA values, with livestock being important ("LM") or necessary ("M"). There was only a small increase in the predictive power of the threshold model (75% correctly predicted status of FA) when environmental factors were included. This limited increase in predictive power is likely to be caused by the noisy nature of this binary dependent variable.

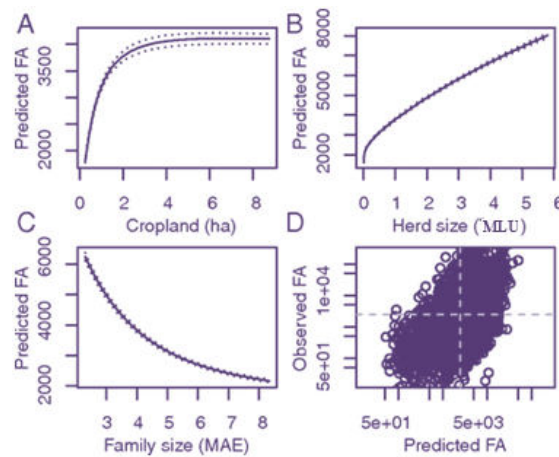


Figure: 6. (A–C) The response curves of the ANN model using cropland (A), MLUs (B), and family size (in MAE) (C) as inputs (on the x axes) and the predicted FA response (in kcal per capita per day) on the y axes. The curves were calculated from the controlled variation of one variable, whereas the other two were set to their median values: crop land, 1.33 ha; MLU, 0.75; and household size, 4.4 MAE. The bold line shows the average response curve, and the dashed line is the average \pm SD. (D) Model performance, with the observed FA (in kcal per capita per day; calculated using measured data) on the y axis and predicted FA (in kcal per capita per day) using the three earlier-mentioned variables as input of the ANN on the x axis. Both axes are in log scale. The dashed gray lines are the daily requirement thresholds of 2,500 kcal per capita per day.

Discussion

Bridging Yield Gaps Is Important, but Improving Market Access Is Essential. Consumption of food crops produced on the cultivation forms the base level of energy supply in all smallholders, but most households start selling food crops before the households' consumption reaches food self-sufficiency. Households sell produce even when they do not produce enough food to be self-sufficient: 83% of the household sell part of their crop produce, and only 4% of the cultivators do not sell anything of their crop or livestock produce. Thus, market access is crucial to ensure or improve the livelihoods of these families. Simply increasing production by closing the yield gaps of important food crops does not necessarily lead to improved food security because many of these food crops (e.g., maize) typically have low market prices (Harris, D., Orr, A., 2014). Closing yield gaps might allow families to buy more food at cheaper prices, thereby helping the food security of the poorest families. However, the results show that the majority of smallholder farmers rely on the sale of food crops to generate cash. Decreasing food prices might be attractive for the poorest families but would have adverse consequences for market-orientated smallholder families. A more logical entry point for the poorest families is therefore to stimulate the labor market for off- cultivation activities. Unless cultivators are able to use improved production levels of food

crops to reach the base level of food consumption on less land, thereby freeing up land to produce cash crops and to market these in return for good prices, the analyses indicate that increased food crop production is not necessarily an attractive entry point for improving the livelihood of these smallholder cultivators. However, the success of this depends on market access.

Livestock Matters for the Poor and the Rich. Livestock provided roughly 20% of the energy of the households. A clear shift in livestock species was observed: the poorest cultivators rely on poultry, and those with better FA own cattle. This shift follows what has been described as the "livestock ladder" across different cultivation (Todd, H., 1998, Udo, H.M.J., 2011). The livestock ladder depicts a system that poor smallholders can use to ascend from keeping small-stock to acquiring larger animals, so a dynamic change over time within the same smallholder. The results show that the upper rungs of the ladder are associated with better FA. However, the ladder does not show whether limiting resources, for example, fodder availability, will limit the ability of cultivators to climb the ladder (Klapwijk, L., 2014).

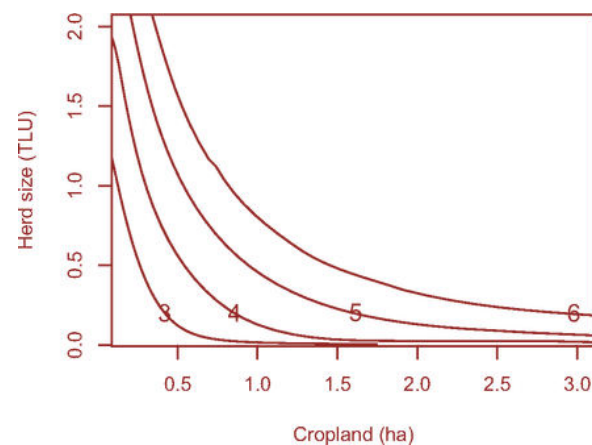


Figure: 7. Predicted FA threshold curves using the ANN with cropland, livestock (in MLU), and family size (in MAE) as inputs. Different curves are the threshold values at different family sizes from 3–6 MAE. Households with productive resources larger than the values determining the curve corresponding to their size in MAE equivalents are predicted to have enough food available to feed the family.

Off- Cultivation Income: The Stabilizer in the Equation. Off- Cultivation income was strongly related to the degree of FA: its importance as a source of energy increased from 12% for the insufficient food-available households to 27% for the more than sufficient food-available households. Off- cultivation income is one of the key options for achieving food security (Otsuka, K., Yamano, T., 2006, Kristjanson, P., Mango, N., Krishna, A., Radeny, M., Johnson, N., 2010). In previous work, off- cultivation income has been shown to be a more important part of the livelihood of the poorest cultivators (Jayne ,T.S., Chamberlin, J, Headey, D.D., 2014), but the analyses, in which consumption of self-produced crop and livestock products is valued highly in calorie intake terms, show the opposite. A wide body of literature (Bezu, S., Barrett, CB, Holden, S.T., 2012, Haggblade, S., Hazell, P., Reardon, T., 2010, Andersson Djurfeldt, A., Djurfeldt, G., 2013) showed that off- cultivation activities are a key source of social and economic stratification in the central Abujhmar areas (i.e., the better-off households tend to have access to the "better paid" non cultivation incomes, whereas the poorer cultivators can only work as seasonal laborers on other cultivation in the region). Separate analyses based on the ABMINT (Abujhmar Intensification) surveys showed that half of the households had no access to non cultivation income, so non cultivation income is not a pathway to food security available to all.

Simple Models and Indicators Needed for Targeting and Upscaling Policy and Development. We developed a simple response model that explained 33% of the calculated variation in the agriculture based FA indicator (so excluding off- cultivation income). Based on the number of livestock and the size of the

household, a threshold value of land size could be defined, above which a smallholder is likely to be able to produce enough food and cash to feed the family. This is a powerful minimodel, because all three variables can be easily and rapidly collected for large numbers of households, in contrast to variables like productivity, consumption, and sales, which need detailed survey instruments and often display high variability and imprecision. Despite all of the approximations (hypotheses of the model, problem of merging datasets, simplicity of the analysis, limited number of predicting variables) and noise in the data, the model predicted correctly the FA status of 72% of the households (Fig: 7). The relationships in Fig. 7 were strongly affected by market access. When cultivators have good market access, the size of the cultivation needed to produce and/or purchase enough food to feed the family secure can be small (Fig. 8). With good market access, cultivators are able to generate cash through the production of high-value crops alongside a base supply of food crops, and buy the food they need. This observation confirms earlier findings (Baltenweck, I., 2003) on cultivators intensifying with cash crops as a result of higher relative factor prices in densely-populated areas with good market access and suggests that indeed Boserup's endogenous intensification of cultivating systems in response to mounting land constraints can be found in our data (Boserup, E., 1965, Herrero, M., 2014).

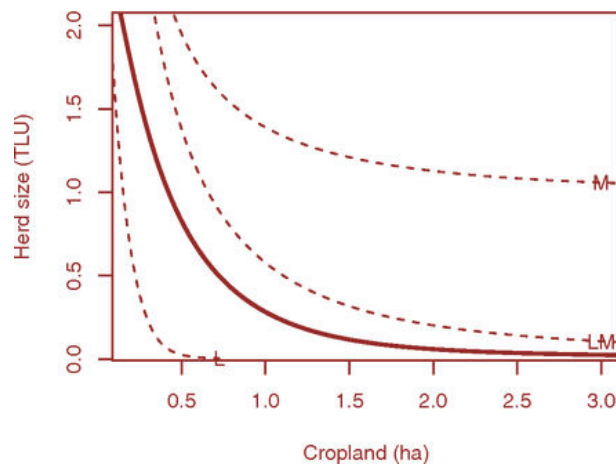


Figure: 8. The predicted FA threshold curves of the ANN model with cropland, livestock (in MLU), and family size expressed in MAE as inputs, together with the environmental constraint variables (for an explanation). The bold line shows the average response and threshold curves (as in Fig.7 but now for a family size of 4.4 MAE). The dashed lines show thresholds for some contrasting constrained environments: land and market constrained environment (LM) (18% of households), land constrained (L) (11% of households), and market constrained (M) (10% of households).

The results show that, when focusing on FA (a key indicator of food security), a substantial part of the smallholder cultivators population in the Abujhmar will face large difficulties in reaching a sufficient level of FA given their small cultivation sizes. This is a critically important finding given that around 80% of the smallholder cultivation in Abujhmar are now smaller than 2 ha. However, we also show that many could potentially increase FA sufficiently to feed the family on relatively small parcels of land through intensification practices involving cash crops and the use of livestock (Jayne, T.S., 2003). This scenario is only possible if market access is ensured and overproduction does not depress prices of the cultivators' produce. Most of the households in the database do not have good market access, and therefore their cultivation size and livestock-holding thresholds are still very important, as shown in the average response threshold of Fig. 7. Current trends in cultivation size development in the Abujhmar are strongly negative in many countries (see Jayne, T.S., 2003, Jayne, T.S., Mather, D., Mghenyi, E., 2010), making the future of smallholder cultivating bleak in many places unless market access can be ensured.

More Land Does Not Automatically Mean More Food Is Available Throughout the Abujhmar. The saturated FA—land size curve of Fig. 7 is caused by a decline in productivity per unit land (expressed in kcal per ha) when land sizes increase in the overall dataset. More detailed analyses shows that this decline in land productivity with increased land holdings per cultivation was visible across all datasets available from the Abujhmar but also occurred within regions with contrasting agro ecological and socioeconomic conditions. Per region, the range of cropland holdings was different, but across these different ranges, land productivity systematically declined with an increase in cropland holding. This finding supports the inverse land size productivity relation that has been found in many studies for smallholder cultivators (Ali, D.A., Deininger, K., 2014, Larson, D., Otsuka, K., Matsumoto, T., Kilic, T., 2013). Recent studies qualify this relationship (Muyanga, M., Jayne, T.S., 2014), showing that medium size cultivation are most efficient per unit area. The results in Fig. 7 change when the environmental constraints are taken into account (Fig. 8), and these results indicate that the inverse land size productivity relation is less severe in land-constrained sites with market access. The relationship between the FA indicator and cropland size is almost flat in sites where there is no land constraint and where there is no market access (e.g., in western Abujhmar regions with low population densities), illustrating that the only way to become food secure in those sites is through livestock holdings in the face of an extremely severe inverse land size productivity relation (Fig 8, 9, 10).

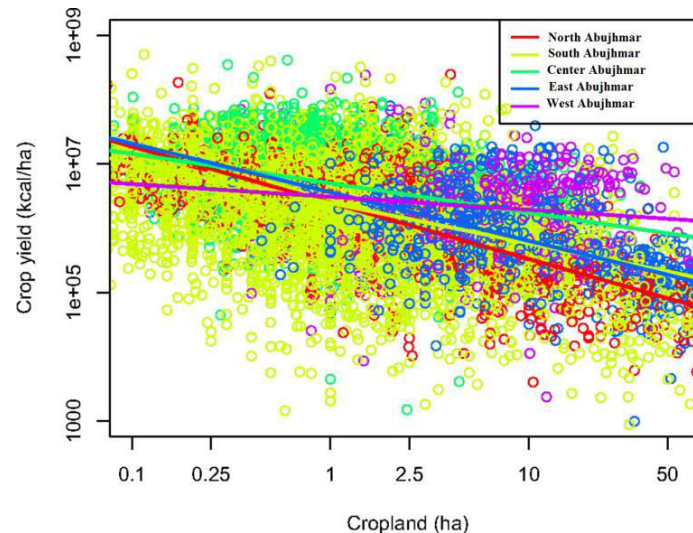


Figure: 9. The crop yield per unit land area versus the total cropland area used per cultivation household. Results are shown for five regions; annual rainfall was 850 mm per year. The slopes of the regression lines [the drawn lines; all expressed in $\ln(\text{kcal per ha})$ per $\ln(\text{ha})$] are -0.9 for North Abujhmar, -0.62 for South Abujhmar, -0.45 for Central Abujhmar, -0.78 for East Abujhmar, and -0.19 for West Abujhmar. Both axes are in log scale.

Targeting More Than Agricultural Development Is a Necessity. The results of these analyses can help with the targeting of food policies because the results quantify the importance of different on and off-cultivation activities to FA, and the importance of market access on the potential of cultivating systems to intensify. The role of off cultivation income and market access clearly shows that rural development in the Abujhmar has to be more than closing yield gaps and agricultural development per se. Connecting people to market centers and generating other employment sources will directly affect food security in a manner that boosting production cannot. As discussed earlier, cultivators start selling produce at levels below fulfilling food self-sufficiency, and increasing productivity of food crops will only lead to substantial improvement in food security if cash crops and intensified livestock production can take place, both needing good market access (Baltenweck, I., 2003, McIntire, J., Bourzat, D., Pingali, P., 1992, Jones Govereh, T.S. Jayne., 2003).

The approach is based on cultivator-reported data, with all of its constraints and limitations (Carletto, C., Zezza, A., Banerjee, R., 2013, Carletto, C., Savastano, S., Zezza, A., 2013). Except for the off- cultivation income estimates, which were biased by the survey of the project in which they were collected, the overall results were consistent across surveys. The analyses presented in this study show how big datasets can be used to identify generic patterns that can be used to prioritize policies, despite the huge diversity in smallholder cultivating systems in the Abujhmar.

Calculation of the Food Availability Indicator. A simple food security indicator was developed building on earlier work by Hengsdijk et al. (Hengsdijk, H., Franke, A.C., van, Wijk M.T., Giller, K.E., 2014). FA was calculated from on- cultivation consumption of food crops, and food that could be purchased on the basis of money earned through on- cultivation and off- cultivation activities (Fig. 4). This indicator of food security does not cover all of the complexity contained in the concept of food (in) security (Coates, J, 2013, Headey, D., Ecker, O., 2013). The indicator estimates the potential annual amount of energy available at household level, and we therefore refer to it as "food availability." The indicator provides a continuous "food-availability scale" that allows us to quantify the contribution of key determinants of FA for individual households within and across sites.

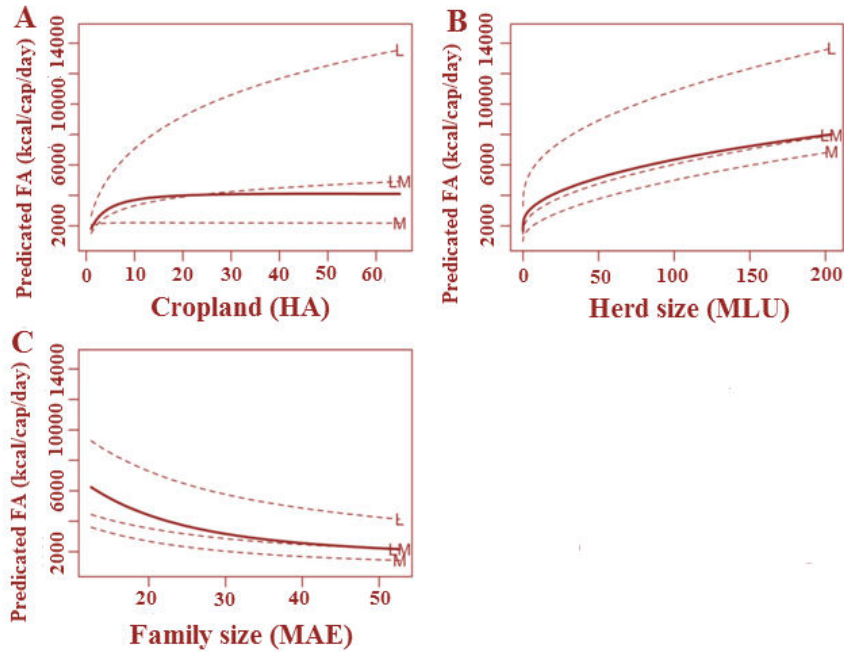


Figure: 10. The response curves (A–C) using the artificial neural network model with cropland expressed in ha (A), herd size expressed in MLU (B), and family size expressed in MAE (C) as inputs, together with the environmental constraint variables. The dashed lines show the average response for some contrasting constrained environments: land and market-constrained environment (LM) (18% of households), land-constrained (L) (11% of households), and market-constrained (M) (10% of households).

FA was expressed in PFE energy (kcal) per capita per day and is calculated according to

$$PEF = \frac{E_{cons} + E_{income}}{365 \times n_{hh}} \quad (1)$$

where E_{cons} is the direct consumption of PFE energy from on cultivation food produce in kcal (calculated from Eq. 3), E_{income} is the indirect consumption of the PFE energy from income (cultivation sales, off-cultivation) in kcal (calculated from Eq. 4), and n_{hh} is the household size in MAE (calculated from Eq. 2).

Household members were disaggregated by sex and age brackets following Food and Agricultural Organization of the United Nations methodology (Food and Agricultural Organization of the United Nations, 2001) to quantify household size n_{hh} in MAE, based on energy requirements for members of each age bracket (Eq. 2).

$$n_{hh} = \sum_i n_i \times a_i, \quad (2)$$

where n_i is number of person in class i , and a_i the percentage of energy requirement of class i [compare with the energy requirement of an adult male with average daily activity, 2,500 kcal/d (Holden, S.T., Shiferaw, B., Pender, J., 2001)].

The PFE energy from direct consumption of on- cultivation produce was calculated as

$$E_{cons} = \sum_c E_c \times m_c \times \theta_c + \sum_l E_l \times m_l \times \theta_l, \quad (3)$$

where E_c is the energy content of the yield of crop c , m_c is the yield of crop c in kg, and θ_c is the percentage of the yield of crop c consumed. For livestock, E_l , is the energy content of livestock product l , m_l is the produced amount of product l in kg, and θ_l is the percentage of livestock produce l consumed. Energy contents were based on a standard product list developed by the Government. The PFE energy from indirect consumption of income was calculated as

$$E_{income} = l_{USD} \times \frac{E_{staple}}{P_{staple}} \quad (4)$$

l_{USD} is the money earned by the household (by selling cultivation production and off- cultivation income) in (calculated from Eq. 5), E_{staple} is the PFE energy content of the staple crop (kcal/kg), and P_{staple} is the price per kg of the staple crop /kg). Only the staple crop was purchased with the money earned because in most surveys, information was lacking on the actual purchase of food items or was only available for a limited period of the year. By only assuming purchase of the staple crop, the actual energy supply of food is likely to be overestimated, and the FA indicator is therefore only an indicator of the potential to generate enough energy to feed the family by the different livelihood activities.

The money earned by the household was calculated as

$$l_{USD} = \sum_c P_c \times m_c \times (1 - \theta_c) + \sum_l P_l \times m_l \times (1 - \theta_l) + \Phi, \quad (5)$$

where P_c and P are the price of the crop yield c (or livestock product l) in kg^{-1} , and Φ is the off-cultivation income .

Data Availability and Quality. We defined the following categories that contribute to FA: food crops consumed, food crops sold, cash crops sold, livestock and livestock products consumed or sold, and off-cultivation income. Cash crops were defined as crops of which more than 90% of the annual produce is sold. To control for the large variability in reported price values for the cultivation products, we took the median value of these prices per kilogram per site.

Data Analysis. The FA analysis was applied to all 267 households in the database. We first quantified the energy contribution of different on and off- cultivation activities to FA for all households. We tested the FA indicator by comparing it to self-assessed food security status where available. In survey, information

per household was available on the number of meals per day; in the CIALCA dataset, information on FA classes was available: each household classified itself in one of four food security classes. Statistically significant correlation coefficients between 0.18 and 0.37 were found between the reported class or level of food security (either expressed as number of meals per day or as a food security class scoring) and the (log-transformed) FA indicator. Therefore, strong variations in the FA indicator were related to variations in the overall food security indicators used for comparison, and the FA indicator, despite its strong underlying assumptions, gave a reasonable insight in the overall food security status of individual cultivation households.

Preliminary analyses showed that the median value for the base level of food crop consumption (expressed as PFE energy) across all individual cultivation households was roughly 1,500 kcal per capita per day. The overall median value of FA was roughly 4,000 kcal per capita per day. These values were used as a proxy to define three FA classes: "insufficient food available" with less than 1,500 kcal per capita per day, "sufficient food available" with between 1,500 and 4,000 kcal per capita per day, and "more than sufficient food available" with more than 4,000 kcal per capita per day. These FA classes were used to explore the relative contribution of different on- cultivation and off- cultivation household activities in detail.

After this data-exploration step, we tried to explain variations in the FA indicator. In this step, we focused on the drivers of the agriculture-related contribution to FA, thereby excluding off- cultivation activities. This exclusion of off-cultivation activities was for two reasons: first, we wanted an explanatory model of FA and off-cultivation activities are less related to on cultivation resources and therefore less predictable; and second, initial analyses showed that values in off- cultivation income were systematically influenced by the way information about this resource was collected in the surveys (a decision tree analysis showed that the name of the survey was one of the key determinants of variations in off-cultivation income). To quantify the relationships between cultivation level resources and FA, we used three key cultivation household level variables to describe variation in FA among households: the crop land used by the cultivation household (in ha), the livestock herd size (expressed in MLU), and the family size (in MAE). These variables were also identified in other studies as important variables of household-level food security (Herrero, M., 2010, Hagglade, S., Hazell, P., Reardon, T., 2010, Holden, S.T., Shiferaw, B., Pender, J., 2001, Ehui, S., Li-Pun H., Mares, V., Shapiro, B., 1998).

Site-level variables were used as discrete variables, because initial test results showed that a functional interpretation of the relationships found between FA values and continuous site variables was extremely difficult. We characterized the sites based on key constraints identified in literature or in the survey data themselves. Three constraints were used: land, livestock, and market (Herrero, M., 2014, Staal, S.J., Baltenweck, I., Waithaka, M.M., DeWolff, T., 2002, Headey, D., Jayne, T.S., 2014). Whether a site was defined as land-constrained or not was based on the country classification of Headey and Jayne (Headey, D., Jayne, T.S., 2014). Whether market access was a constraint was based on the importance of cash crops in a site in the survey data: sites with less than 25% of the cultivation households growing cash crops were labeled as "market-constrained." "Livestock-constrained" sites were sites where less than 50% of the households owned 0.7 MLU. Variables describing the agroecological environment of the sites (e.g., rainfall, soil) were included in initial analyses, but either the variables did not result in balanced data divisions or the site-level GPS information was too coarse. Therefore, we did not include the biophysical site-level variables in this analysis.

Because the relationships between FA and the explanatory variables were expected to be nonlinear, with strong interactions present between the drivers, we used ANNs to quantify these relationships. ANNs produce the best possible empirical relationship between the input and output variables presented to the network. A standard three-layer, back-propagation network was used with, after testing different numbers, four hidden neurons. The networks were trained on 75% of the available data, whereas 25% was used for testing. The ANNs were cross-validated 500 times, and in each sampling, 50 initializations of the neural network architecture were used. At the end of the analysis, 500 different networks were available per combination of input variables, which were used to quantify the uncertainty in the network performance and the response curves that were generated with the networks. We checked

the relationships found by the ANNs between FA values and changes in household size to make sure the ANN models were not simply identifying the inverse household-size relationship used in the FA calculations, resulting in circular reasoning.

The Marias as Hunter and Gatherers in the Abujhmar

*Famine has never been problem in Abujhmar as the Marias
have always been able to draw half of their food supplies from
the innumerable edible products of the vast forests.*

*Whatever came across them they must needs kill and eat it;
They made no distinction. If they saw a jackal they killed
And ate it; no distinction was observed; they respected not antelope,
sambhar and the like.*

*They made no distinction in eating a sow, a quail, a pigeon,
A crow, a kite, an adjutant, a vulture,
A lizard, a frog, a beetle, a cow, a calf, a he- and a she-buffalo.
Rats, bandicoots, squirrels—all these they killed and ate.
So began the Goods to do. They devoured raw and ripe things.'
(Hislop's version of the Lingo epic of the Gonds.)*

In terms, hunter-gatherers are defined to large extent by their economy. Forager subsistence (food, fuel, fibre, etc.) is derived from non-domesticated resources, not actively managed by themselves or by other human beings. The Marias are getting their livelihood fully or predominantly by some combination of gathering, collecting, hunting, fishing, trapping, or scavenging the resources available in the plant and animal communities around them. By this definition, key properties of this form of economy are ecological in nature. While there are different and sometimes more precise definitions of hunter-gatherers, this one has the advantage of simplicity. It does not confuse primary with derivative and more variable features of this lifeway, such as 'band-level' social organisation or an egalitarian social ethic.

Although we can define and delimit a category - the hunter gatherer form of economy - we must immediately add that the Marias so encompassed are highly diverse. Although the number of Maria population represent had dwindled by the beginning of their ethnographic documentation. The Marias of the Abujhmar like Shoshoni of the Great Basin, the Australian Aborigines, the arctic Inuit, the Aka of the Philippines, the Mbuti, Hadza, and Ju/'Hoansi of Africa, and the Ache of Paraguay are well-known examples of hunter and gatherer. They vary along every imaginable dimension of socioeconomic comparison: in the diversity and types of food and other resources consumed, in degree of task group and residential mobility, in forms of intra- and inter-group exchange and land tenure, in group size and structure, in male and female role differentiation, and along a spectrum of egalitarian to more stratified social organization. Despite considerable variety, the comparative study of the Maria hunter-gatherers provides four generalisations that require explanation. Despite exceptions, these features stand out as common patterns. They are: (1) apparent under-production, and a general lack of material accumulation; (2) routine food sharing; (3) egalitarianism; and (4) despite number 3, a routine division of labour between the foraging activities of males and females: men more commonly hunt while women more commonly gather. Resource might also be localised in discrete *patches*, with intervening spaces empty of desirable items. This situation is addressed by models of patch choice and patch residence time. Within a patch, the rate at which food can be harvested declines as a function of the time the forager spends there. The most accessible and dense clusters of ripe fruit are harvested before moving to more difficult and less attractive ones. This is a common situation for Marias, and it raises two questions: Which patch types

will be included in the set harvested? How much time should be dedicated to each patch before moving on to a fresh one?

The first question is answered by use of an algorithm like that for selecting resource items, with patches ranked by their initial net acquisition rate NAR. The second question is answered by the *marginal value theorem*, or MVT (Charnov 1976), shown in Figure 11. An optimal forager abandons a patch when its declining *marginal* rate of return equals the net acquisition rate NAR of foraging averaged over visits to many patches. Increasing encounter rates (lessened travel times) raise foraging efficiency and reduce patch residence time; lessened search costs have the same effect. As patches become richer or as harvest costs within the patch diminish, residence time also decreases. A forager moves more quickly through an environment dense with rich patches, taking less from each one encountered, than through an environment with fewer and/or lower-quality patches. A forager nearly always will depart a patch before it has been fully depleted of resources. As an incidental consequence of this pattern, the forager leaves behind the breeding stock that will allow the patch to recover.

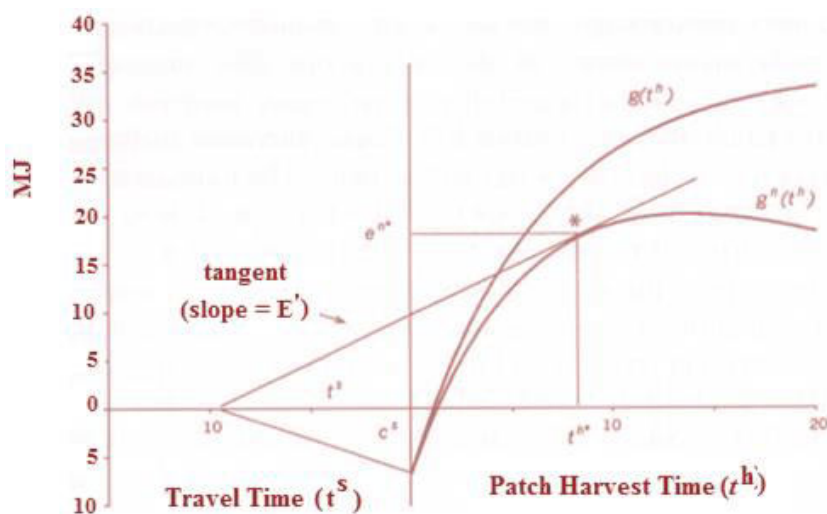


Figure: 11 The marginal value theorem for one patch type. The forager expends time (t_s) and incurs energy costs (c) travelling between patches in search of a favourable patch to exploit. Within such a patch, its *gross* rate of resource gain - $g(t_h)$ - diminishes as a function of time. This gain function is offset downward by c , to cover travel costs. The slope of the forager's *net* gain function - $g^n(t_h)$ - gives the instantaneous net rate of return. This rate becomes negative if the rate of gross intake falls sufficiently that it fails to cover metabolic expenditures. The optimal patch residence time (t_h^*) is found by drawing a line from the x-axis travel cost (here, $t_s = 9$ hrs) that is tangent (*) to the net gain curve, $g^n(t_h)$. The slope of this line gives the best possible net acquisition rate or efficiency (E_f) of foraging [$E_f = en^*/(t_s + t_h^*)$]. This establishes the general rule that an optimal forager abandons a patch when its declining *marginal* rate of return equals the average efficiency of foraging. Beyond t_h^* the forager's rate of resource acquisition would be below what it can achieve by locating and harvesting additional patches. Other predictions about patch residence are derived by manipulating the variables represented in the graph (e.g. travel time, t_s) or the shape of the resource gain function. A simple extension of the model will handle multiple patch types (Charnov 1976).

Although human and primate behavioural ecologists report anecdotal observations that are qualitatively consistent with predictions of the marginal value theorem, we do not know of quantitative, anthropological tests of the model. For instance, McGrew observes that each "dip" of the twig used by termite-fishing chimpanzees returns fewer of the edible insects. When yield drops sufficiently, the chimp will leave and travel the distance to a new mound to begin anew. How closely chimpanzees match the optimum departure point is unknown, but the general pattern is consistent with the MVT. The MVT introduces a second concept borrowed from micro economics and essential to the analysis of foraging and other types of economy: *marginal analysis*. The value of many economic choices or activities changes as a function of their magnitude or duration.

The quantity of a good accumulated, the duration of a productive task, and the time since an activity has been performed are examples. A decision to stop consumption or to cease one activity in preference for another is made by comparing the value of the last unit gained to the alternative. Thus the *marginal* value of the current patch is compared to the average value of moving on. In the encounter-contingent model, the value of the next ranked resource is compared to the marginal value of the resource set without it

The models examined so far are concerned with production. They analyse the selection of resources and how this is affected by factors such as their value, density and predictability, as well as their local and regional patterns of spatial distribution and defense (Cashdan, 1992).

Characteristics and Food habits in the Marias of Abujhmar

Roy and Rao (1957) made a survey of the food habits of the Marias of Abujhmar. They found that the main cereal consumed by the Marias is rice (*Oryza sativa*); other cereals used by them are Kodon (*Setaria italica*), Kutki (*Panicum miliaceum*) and Mandia (*Eleusine coracana*). These are grown in fields on hill slopes or in valleys. Their principal pulses are Urid (*Phaseolus mungo*), Kulthi (*Dolichos biflorus*) and Mung (*Phaseolus radiatus*). These are grown in fields or in , the kitchen garden. In famine and scarcity the Marias would use grains of bamboos and other grasses as cereal.

Vegetables are regularly eaten by the Marias, either cooked along with the Pej or as separate preparation. These may be leafy vegetables or the non-leafy and tuberous vegetables. Few vegetables and almost no fruits are grown by them; for a supply of these the Marias look chiefly to the natural forest produce.

Some of this forest produce is consumed as it is collected in the forest. Such is the case with all edible fruits, some tubers and tender shoots. Palatable seeds also are eaten raw or roasted in the forest. Such products are rarely brought home. They would not be found stocked in the Marias home and are likely to escape record by surveyors. The relative proportion of the foodstuffs collected from the forest and those grown in field or varies from family to family and even more so from month to month. Roy and Rao (1957) found that 76 g (2-73 oz) of leafy vegetables and other vegetables including roots are consumed per consumption unit. This is about ten per cent of their total daily food intake (820 g, 29-3 oz) per unit.

The fact that women and children collect leaves, flowers and fruits from the forest regularly and the men would dig out tubers whenever necessary would indicate that forest produce would often make more than ten per cent of their daily food intake. As mentioned above, certain amount of fruits or seeds are eaten by the Marias while working and wandering in the forest and this remains off the record. We may recall here Grigson's (1949) statement that famine has never been a problem in the Marias have always been able to draw *half* of their food supplies from the innumerable edible products of the vast forests. There are very few things which they do not collect.

It would seem that all plants which are known to them as non-poisonous or non-injurious are subjected to use as food. Even some of those plants which are bitter or acrid are purified and then eaten. Such is the case with yams and *Euphorbia* spp. It is also probable that in the absence of many cultivated vegetables and fruits the Marias tends to break the monotony of his routine diet of Pej by getting used even to some less palatable natural forest products.

The general notion that the Abujhmarias living in forests consume very large quantities of meat is not correct for the Abujhmar. According to Roy and Rao (1957) meat and fish consumption here is only about 5-6 g (0-2 oz) per consumption unit; not a single family was found by them taking meat regularly. The average intake of animal protein, therefore, per day per consumption unit is only 1-2 g whereas consumption of vegetable protein is 78-4 g (the recommended daily allowance of protein is 82-0 g or more). This should, however, be borne in mind that generally tribal people are hesitant to talk freely about their meat and fish consumption; they are afraid of punishment for hunting and fishing.-dwellers. These aspects fall within the regime of a nutrition scientist. A catalogue of all plants reported to be used for eating purposes supplies basic material for nutritional research.

Food Insecurity and Coping Strategies in Marias

In this research work an attempt is made to measure individual food security in the Abujhmar with the help of Coping Strategy Index (CSI) also an endeavor is made to analyze differences in number of Coping Strategy used and Value of Coping Strategy index for the Abujhmar.

Materials and methods

This study set out to investigate the food insecurity coping strategies of sample households from areas of the Abujhmar which contains 5 sub areas including South, North, East, West, and Central, Abujhmar. A total of 267 households were interviewed, in the Jun to July, 2016.

A survey questionnaire was used to collect data on socio-economic characteristics and application of consumption coping strategies. The study used the Coping Strategy Index to establish the food security status of the households by calculating and comparing the Coping Strategy Index Scores of households. Coping strategies included in coping strategy questioners are as follow; 1) Draw maximum food supplies from vast forest, 2) Accumulate live stock or other assets, 3) Marketing of forest product, 4) Sale of live stock, 5) Exchange of animals for cereals, 6) Marias are omnivorous, 7) Shifting Cultivation, 8) Women and children gather food from forest, 9) Forager subsistence, 10) Routine food sharing, 11) Egalitarian.

After calculation of numerical value of coping strategy index for each household with usage of K mean cluster analysis method which is performed with the help of SPSS (v.19) software, households were classified in according to their respective coping strategy value. In order to test differences in food insecurity condition of households LSD test is performed on coping strategy values with the help of SAS software.

Results and discussion

Results of this research work is presented in two parts, first parts include calculation and classification of households coping strategies based on K mean cluster analysis and LSD test.

Table 1. Frequency of distribution of coping strategies in the Abujhmar

Coping strategy	% of household using coping strategy										
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Most of the times	45.32	5.62	13.11	16.48	5.24	12.73	17.89	4.12	5.25	1.50	3.75
Some times	26.96	13.86	19.10	24.34	7.12	21.72	18.73	6.74	9.36	4.12	3.75
Rarely	3.75	1.87	4.496	4.12	3.75	4.50	5.24	3.37	0.38	1.87	2.24
Never	20.97	78.65	63.30	55.06	83.89	61.05	58.77	85.77	88.01	92.51	90.26
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Research Finding

Table 1 shows frequency of distribution of coping strategies in the Abujhmar.

Table 1 shows that first coping strategy (Draw maximum food supplies from vast forest) is used by 45.32 percent of house hold 4-7 times during a week, 29.96 percent of households used this coping strategy 2-3 times a week, this strategy is used by 3.75 percent of household at least once in a week and 20.97 percent of households never used first strategy.

The second strategy (Accumulate live stock or other assets) is implemented by 5.62 percent households 4-7 times during a week, 13.26 percent of household used the second strategy 2-3 times during a week, and 1.87 percent of households applied second strategy once in a week and 78.6 percent never used this strategy. This is important to mention the fact that this strategy is something which is against family pride in the Abujhmar therefore households are trying to use harsher strategies instead of using this strategy.

The third strategy (Marketing of forest product) is implemented by 13.11 percent of households 4-7 times weekly. 19.1 percent of household used the third strategy 2-3 times during a week and 4.49 percent of households used this strategy once in a week while 63.3 percent of households never used this strategy.

Forth strategy (Sale of live stock) is used by 16.48 percent of households 4-7 times weekly, 24.34 percent of households applied this strategy 2-3 times, 4.12 percent of households used forth strategy once in a week and 55.06 percent of households never used this strategy.

Fifth strategy (Exchange of animals for cereals) is used by 5.24 percent of household 4-7 times weekly, this strategy is used by 7.12% of households 2-3 times, 3.75% of households applied this strategy once during a week and 83.89 percent of households never used strategy number five.

Sixth strategy (Marias are omnivorous) is used by 12.73 percent of households 4-7 times a week, 21.72 percent of households used this strategy 2-3 times weekly, 4.5 percent of them implemented this strategy once during week and 61.05 percent of households never used this strategy.

Seventh coping strategy (Shifting Cultivation) was put in use by 17.98 percent of households 4-7 times yearly, 18.73 percent of households used it 2-3 times, 5.24 percent of households applied this strategy once during a year and 58.05 percent of households never used this strategy.

Eighth coping strategy (Women and children gather food from forest) is used by 4.12 percent of households 47 times weekly, 6.74 percent of households used this strategy 2-3 times, 1.87 percent of them used this strategy once in a week and 92.51 percent of households never used this strategy, which is an indicator of severity of this strategy.

Ninth coping strategy (Forager subsistence) employed by 2.5 percent of households 4-7 times weekly, 9.36 percent of households used this strategy 2-3 times, 0.38 percent of household applied the strategy once in a week and 88.01 percent of household never used the ninth strategy.

Number tenth strategy (Routine food shairing) is used by 1.5 percent of households 4-7 times in a week, 4.12 percent of households used this strategy 2-3 times weekly while 1.87 percent of households used this strategy once in a week and 92.51 percent of households never implemented this strategy.

The last coping strategy is very important and Marias are still regards the crops as the result of the combine labours of the village individuals. If one suffers, all suffer, and all combine to support the old and the needy, and to help each fellow villager to get through the heaviest parts of the yearly agricultural round. The young man on marriage, or the fellow clansman settling in the village, must have his share of the village lands for cultivation. In the raising of crops, then, the village and not the individual cultivator is the unit, even now, in the Abujhmar hills.

Table 2. Number and percentage of users of each coping strategy in the Abujhmar

Coping strategy	Number of household	% of household using food coping strategy
Draw maximum food supplies from vast forest	250	93.63
Accumulate live stock or other assets	73	27.34
Marketing of forest product	101	37.82
Sale of live stock	99	37.07
Exchange of animals for cereals	88	32.95
Marias are omnivorous	78	29.21
Shifting Cultivation	178	66.66
Women and children gather food from forest	210	78.65
Forager subsistence	77	28.83
Routine food sharing	77	28.83
Egalitarian	75	28.08

Source: Research Finding

Table 2 shows number and percentage of households that are using each of coping strategies in areas of the Abujhmar.

Table 2 shows that first coping strategy (Draw maximum food supplies from vast forest) is used more than other coping strategies (250 households used this coping strategy) followed by Women and children gather food from forest which is used by (210) households. This strategy is followed by Shifting Cultivation. (178) house hold appreciated this coping strategy). Households employ different mitigation and coping strategies in times of food deficit. Food insecurity is naturally induced shock or risk and coping mechanisms are those commonly used in risk management.

The potential food insecurity coping strategies practiced in the study areas include Marketing of forest product (101), Sale of livestock (99), Exchange of animals for cereals (88), Marias are omnivorous (78), Forager subsistence (77), Routine food sharing (77), Egalitarian (75), Accumulate livestock or other assets (73). Based on data presented in table 2 we can sort coping strategies according to their severity from the point of view of the Maria households (table 3).

Calculation of numerical value of coping strategy index shows that the value of coping strategy index lies between 9 to 36 with mean of 15.52, median of 14 and mode 9. The highest value of coping strategy index is 36 which means households that their value of coping strategy is as high as 36 are using most sever coping strategy, households value of coping strategy equal to 9 means households are not using any coping strategies and can branded as food secure households. Therefore we can conclude that 47 households (17.60% of total households) are households that can be classified as food secure households and rest of the households that have used any of coping strategies could be classified as experiencing some degrees of food insecurity. In order to classify food insecure households K mean cluster analysis is utilized. With application of K mean cluster analysis food insecure households classified in three classes with 99% confidence level.

Table 4 shows results of variance analysis for classification of numerical values of food insecurity using K mean cluster analysis.

Table 3. Coping strategies based on severity to Maria households of the Abujhmar

Coping strategy	Number of household	% of household using food coping strategy
Draw maximum food supplies from vast forest	250	93.63
Accumulate live stock or other assets	210	78.65
Marketing of forest product	178	66.66
Sale of live stock	175	65.54
Exchange of animals for cereals	101	37.82
Marias are omnivorous	99	37.07
Shifting Cultivation	88	32.95
Women and children gather food from forest	77	28.83
Forager subsistence	77	28.83
Routine food sharing	77	28.08
Egalitarian	75	27.34

Source: Research Finding

Table 4. Results of analysis of variance using K mean Cluster analysis.

Coping strategy index	Class	df (degree of freedom of Error)		F	a(significant level)	
	Df	mean	Df	mean		
	2	3760.467	217	7.493	501.873	0

Source: Research Finding

Based on information provided in table 4, SPSS software classified food insecure households in 3 clusters (classes). Results of this classification are summarized in table 5.

Table 5. Classification of food insecure households with k mean cluster analysis

Class	Frequency	Relative Frequency	Center of Clusters
Low food insecurity	10	3.75	1.20
Moderate Food insecurity	141	52.80	13.24
Severe Food Insecurity	69	25.85	23.86

Source: Research Finding

Table 4 shows that 10 households (3.75%) are suffering from low level of food insecurity while 141 households (52.80%) are bearing a moderate food insecurity and 69 (25.85%) of households are experiencing severe food insecurity.

Difference between the Abujhmar areas

Table 6 shows results of ANOVA test between all the Abujhmar areas. Results show that there is significance difference between the Abujhmar areas based on number of applied coping strategies and weighted sum of coping strategies at 5% significant level.

Table 6. ANOVA test (number of applied coping strategies and weighted sum of coping Strategies).

	Df	Number of applied Coping Strategies	Weighted Sum of Coping Strategies
Abujhmar Areas	5	5.13	57.95
Error	143	2.45	26.69
Coefficient of Variation (CV)	-	69.72	33.63

Source: Research Finding

Results of LSD test (table 7) indicates that from the stand point of number of applied strategies by Maria households, can be put in two groups of a and b. rural district that were classified in a used more coping strategies compared with Abujhmar areas that classified in group b, that means there is significant level between two groups of a and b with confidence level of 95%. Therefore based on table 7 we can conclude that north, south, east, west, and central Abujhmar is classified in group b which means Central Abujhmar is in better food security condition comparing with other areas. Table 7 also reveals that from the stand point of weighted sum of coping strategies (value of coping strategy index), other areas are classified in two groups of a and b. South Abujhmar (16.77) has highest difference with North Abujhmar, East and West are classified in both a and b groups which means they have no significance difference either with each other or with South and North Abujhmar from stand point of value of coping strategy index.

Table 7. Results of LSD test at 95% confidence level

Area	Number of applied Coping Strategies	Weighted Sum of Coping Strategies
North Abujhmar	1.5 ^b	13.2 ^b
South Abujhmar	2.4 ^a	16.34 ^a
Central Abujhmar	3.54 ^a	16.77 ^a
East Abujhmar	2.31 ^a	15.42 ^{a,b}
West Abujhmar	2.36 ^a	15.06 ^{ab}

Source: Research Finding

Conclusion

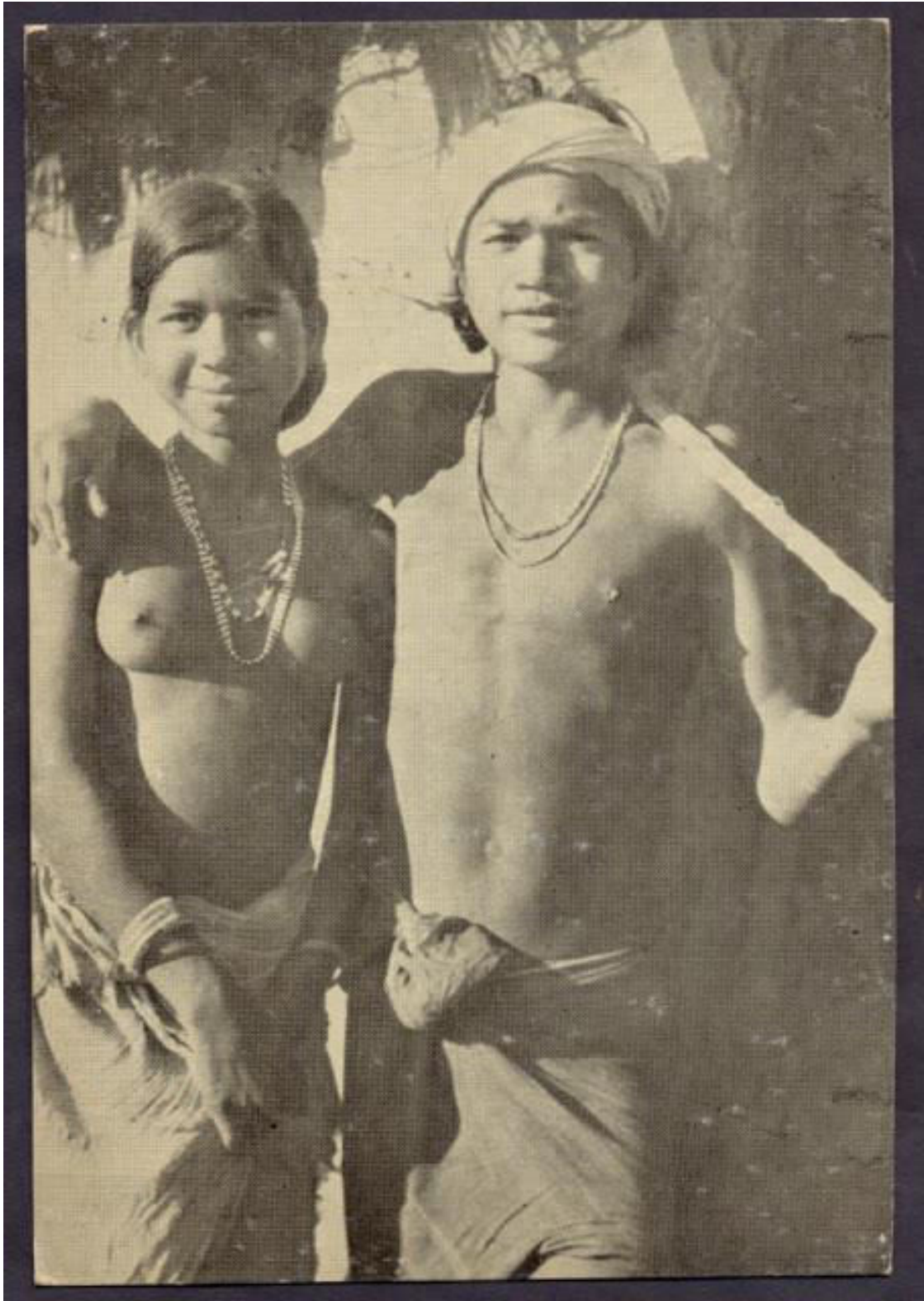
The Abujhmar, probably the least known part of India, The Maria tribe of Abujhmar hills seems to be the most primitive and isolated 'aboriginal' race of India. The whole life of Maria is primarily directed towards raising of food from the earth either by cultivation or by gathering the fruits of the forest or by fishing, hunting or trapping. The difficulty is not so much to say what they collect and eat as what they do not; in fact they eat whatever may be eatable. The Marias are as omnivorous and it is difficult to discover what they will not eat if he can get it. We calculated a simple indicator of food availability using

data from 93 sites in 17 villages across contrasted agroecologies in Abujhmar (> 200 households) and analyzed the drivers of variations in food availability. Crop production was the major source of energy, contributing 50% of food availability. The off- cultivation income contribution to food availability ranged from 12% for households without enough food available (18% of the total sample) to 27% for the 58% of households with sufficient food available. Using only three explanatory variables (household size, number of livestock, and land area), we were able to predict correctly the agricultural determined status of food availability for 72% of the households, but the relationships were strongly influenced by the degree of market access. The analyses suggest that targeting poverty through improving market access and off-cultivation opportunities is a better strategy to increase food security than focusing on agricultural production and closing yield gaps. This calls for multisectoral policy harmonization, incentives, and diversification of employment sources rather than a singular focus on agricultural development. Recognizing and understanding diversity among smallholder cultivation households in Abujhmar is key for the design of policies that aim to improve food security. Measuring food security condition in a given community is one of the most important issues in food security studies. Coping strategy index is an index of food security that is simple to measure, can be used rapidly and is correlated with other complex indices of food security. Application of CSI to measure food security condition in areas of the Abujhmar indicates that the exact value of coping strategy index varies between 9-36 in study areas of the Abujhmar and there is significant difference at 95% significance level between the Abujhmar region as far as exact value of CSI is concerned. The results also showed that first coping strategy (Draw maximum food supplies from vast forest) is used more than other coping strategies (250 households used this coping strategy).

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Marial Man and Woman - India



Maria dancer with a mask cowrie shells playing a large cylindrical drum.



Maria girls of Abujhmar during a dance, wielding sticks with rattles attached; their necklaces and armlets are made of white metal.



Maria girl wearing silver nose-studs and ear rings, and several strings of glass beads



Maria Woman of Abujhmar



Maria Woman of Abujhmarh



Maria Woman is feeling happy after getting Landa.



Woman are preparing liquor from Mahuwa



Abujhmar village house are Eco- friendly in nature, made by bamboos and mud's. The houses in Abujhmar villages are mostly built of bamboo with thatched roofs. Wall and floor of the village houses are by painted by a mixture of dirt, grass, and cow shit. Before and after rain, these house need a maintenance every time. Most of the people who live in villages are farmers, other works as potters, carpenters, blacksmith. Bull's are use for farming and other activity in field. Women work planting the rice paddy, while the men work pulling bullock carts, tilling new soil etc.



Food: Abujhmaria cuisines are very delicious, rice is one food item that is eaten widely in various ways. Most of the traditional and tribe foods are made of rice and rice flour like Pakhal Bhat, Kosra, Angakar Roti and Rice Flour Chapati. The Maria village people enjoys native delicacy brew made of small, creamy white fruit of a local tree called Mahuwa. Mahuwa is extremely popular across the width and breadth of Chhattisgarh, other cuisines are rakhia badi and jalebis to bafauri and petha.



Bastar Beer prepared from Sulfi



Red ants play an important role in food and medicine for the Abujhmaria.



Landa in leaf cup



Beyond The Frame: Maria of Abujhmar



Marias Horned Ironwork Wall Mask Hanging from Abujhmarh Village



Maria dance



Tattooed Maria Woman Drinking Madum,



Abhuj Maria women arriving at the weekly market in Orchha



It's a riot of colour and a precarious balancing act across great distances



All set for the long trek home that will last two days



An Abhuj Maria mother with her kids and a sling bag with small products to sell at the haat



Abhuj Maria women usually carry babies in slings; the men's attire is usually a shirt and a lungi



A few women get their babies some medical attention at the haat, often from quacks



That kid knows what he wants, but his mom isn't so excited by the crunchies and sweets he's pointing to



At the end of the day, the market is also a space for people to relax and have a drink



Red ant chutney in the making



Jogi San with the mortar and pestle, crushing the ants



The esteemed lunch coterie



The final dish: oil-less chicken



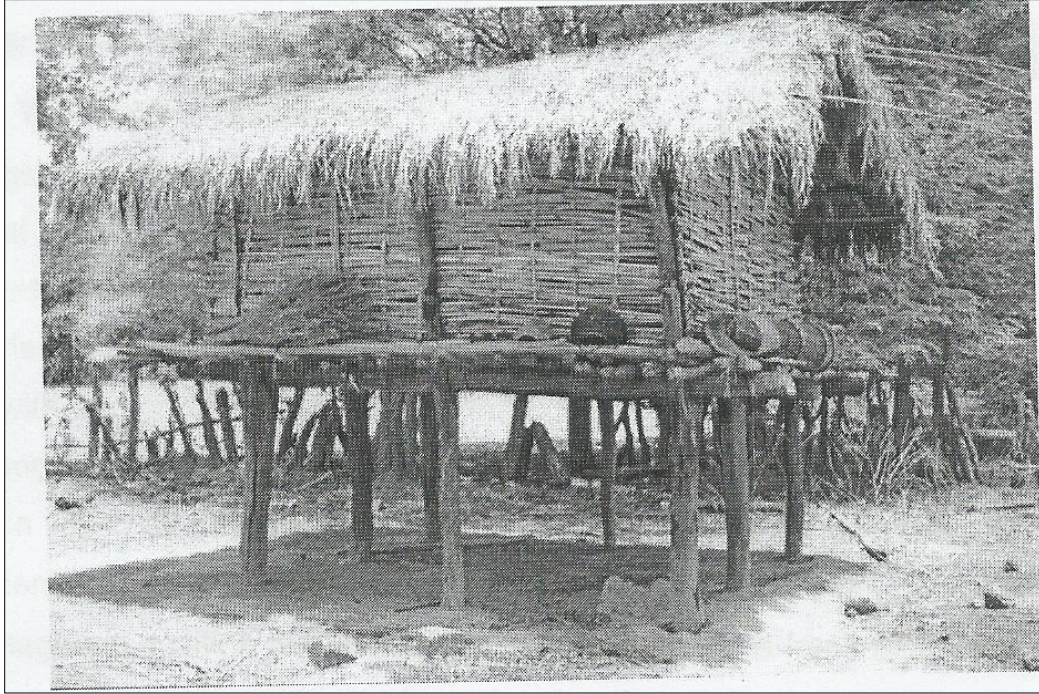
This beautiful woman in a remote village of Abujhmar in India.



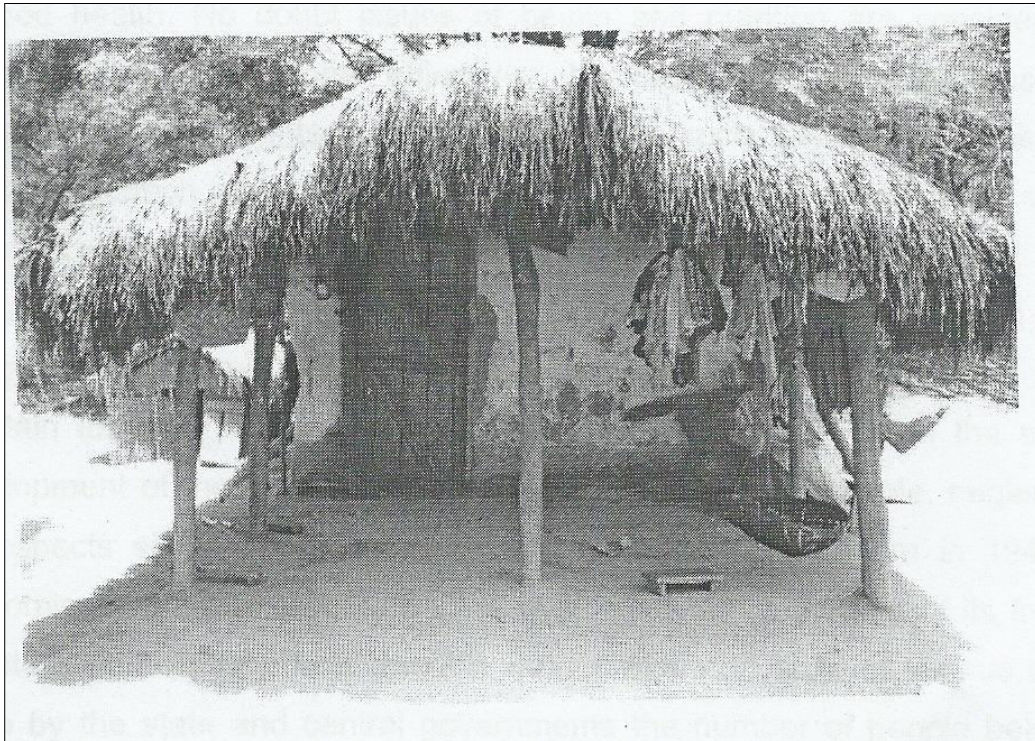
A Maria man from tribal planet of Abujhmar



The Maria girl ready for dance.



Storage hut for storing grains



Typical house of Maria



Prepared food ready to eat for Maria



Maria household



Three ladies are drinking Landa



Lady picking rice



The boy beating the drum for calling dancers