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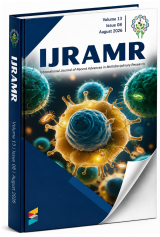

RESEARCH ARTICLE

TRADITIONAL METHODS OF PEST CONTROL PRACTICED BY THE TRIBAL COMMUNITIES OF SATPUDA AND AJANTA HILLS IN MAHARASHTRA

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ABSTRACT

The Kenya Tribal groups living in the Satpuda and Ajanta hill areas of northern Maharashtra, such as the Bhil, Pawara, Koli Malhar, Tokre Koli, Pardhi, Gavit and their smaller groups, have been farming for many years using traditional knowledge that is good for the environment, inexpensive, and part of their culture. This paper looks at how these communities manage pests in five districts: Jalgaon, Dhule, Nandurbar, Chhatrapati Sambhajinagar, and Jalna. The study uses data from census reports from 1961 to 2011, surveys in 115 villages across twelve administrative regions, and observations of local customs. It records various traditional methods like using plant-based solutions (especially neem leaf extracts), smoke, and soil treatments, making natural fertilizers from cows, using a special plant mix called Dashparni Ark, trapping pests physically, and storing grains in traditional ways like the Kangi system. The analysis shows that the Bhil are the largest group among these tribes, and Nandurbar is the district with the highest concentration of tribal people since it was formed in 1998.The study highlights the smart, eco-friendly farming practices of these communities and suggests that their traditional knowledge should be combined with modern pest control methods to help create better, low-cost farming in the dry areas where these tribes live.

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INTRODUCTION

India's rich ecological and cultural diversity is greatly influenced by indigenous communities who live closely connected to forests, traditional customs, and farming practices. In the Satpuda and Ajanta hill areas of Maharashtra, tribes such as the Bhil, Pawara, Koli Malhar, Koli Tokre and Pardhi, along with their subgroups, show a deep understanding of the natural environment developed over many centuries. These communities have long used local methods to protect their crops from pests using natural materials found in nearby forests and homes. These practices are part of what is called traditional ecological knowledge (TEK), a body of knowledge, beliefs, and practices passed down through generations. This knowledge helps people relate to their surroundings and is now gaining recognition as a valuable part of environmental science rather than something outdated. The study aimed to document these methods before they are lost due to deforestation, habitat loss, the spread of chemical pesticides, and climate change. Unlike modern farming that uses a lot of chemicals, tribal methods focus on keeping nature balanced. They use things like plant-based sprays, cow dung and urine mixtures, mixed farming, smoke, and natural insects to control pests. This shows a deep understanding of how farm ecosystems work, even though it's not formally taught. The global trend towards safer farming solutions, such as biopesticides, is growing. The market for these products is expected to increase significantly in the coming years, making tribal knowledge more relevant than ever. India officially recognizes 573 tribal communities, of which 47 are in Maharashtra. This research has three main goals: to understand the geography and numbers of tribes in certain areas using census data from 1961 to 2011, to document the pest-control and food-preservation methods still in use in the region through fieldwork, and to look at how this knowledge can be used in modern farming and environmental policies. References to tribal communities can be found in ancient Indian stories such as the Ramayana and Mahabharata, where characters like Shabari and Eklavya are mentioned. Historical kingdoms like Gondvana and Bhilwad were ruled by tribal leaders, highlighting the long presence of tribes in the area. Modern studies on this topic include works by Patil, who looked at how forest policies have affected tribes, and the Indira Gandhi National Tribal University, which studied over

200 tribes. Recent research also shows that many tribal farmers depend on chemicals and lack awareness of the dangers, calling for the use of safer alternatives like biopesticides and Integrated Pest Management (IPM). Studies like those by Sawant and Jagtap, who listed nearly 80 plant species used for controlling pests, and Rao, who looked at the chemical properties of Indian medicinal plants, support this. Research by Joshi and More in Madhya Pradesh identified several traditional methods using cow products and natural plants. Patel and D'Souza examined how Indigenous Technical Knowledge can complement formal IPM tactics. Rathore *et al*. found that many traditional practices are scientifically sound, as confirmed by entomologists. A similar approach is seen in other parts of India, showing that these methods are widely used across different regions and settings, suggesting they are part of a broader ecological adaptation. This body of work highlights the vast, largely unknown traditional knowledge held by tribes, the risks caused by heavy dependence on pesticides, and the promise of combining this knowledge with modern methods. However, more long-term trials and attention to how this knowledge is passed down, particularly through generations, are needed. The current study aims to fill this gap with detailed documentation from tribes in the study area.

Study Area

The study covers five contiguous districts of northern and north-central Maharashtra-Jalgaon, Dhule, Nandurbar, Chhatrapati Sambhajinagar and Jalna-together spanning approximately 43,633 km² and lying between roughly 20°00′–22°03′ N and 73°85′–76°53′ E. These districts flank the Satpuda range to the north and the Ajanta range to the south and are drained principally by the Tapi and Purna rivers. Geologically, the region lies on the Deccan Plateau and is dominated by Cretaceous–Eocene Deccan Trap basalts, with intertrappean sedimentary beds, Quaternary alluvium along the Tapi–Purna basins, more than 210 mapped dolerite dyke swarms in the Nandurbar–Dhule tract, and older Precambrian Vindhyan–Cuddapah sediments exposed in Jalna and Chhatrapati Sambhajinagar. Elevation ranges from about 64 m in the river plains to 1,293 m in the hill tracts, and soils range from fertile Vertisols and Phaeozems in the lowlands to shallow Cambisols on the upland fringes. The climate is semi-arid to sub-humid, with annual rainfall around 690–700 mm in Jalgaon, summer temperatures reaching 48°C, and winter lows near 10°C — conditions that have shaped both cropping calendars and the traditional pest-management practices discussed below.

MATERIALS AND METHODS

The study combined secondary demographic analysis with primary ethnographic fieldwork. District- and tribe-wise Scheduled Tribe population figures were compiled from the decennial Census of India (1961–2011) for the five study districts. A structured village survey was then conducted across twelve tahsils — Raver, Yawal, Chopda, Chalisgaon and Erandol in Jalgaon district; Sillod in Chhatrapati Sambhajinagar; Bhokardan in Jalna; Shirpur in Dhule; and Shahada, Dhadgaon, Akkalkuwa and Taloda in Nandurbar — covering a total of 115 villages, of which 65 (81.3 percent overall) reported 95–100 percent Scheduled Tribe population. Latitude/longitude, total population and percentage tribal population were recorded for each surveyed village using GPS-referenced Primary Census Abstract (2011) data. Ethnographic data on pest-control and food-preservation practices were gathered through semi-structured interviews and participatory observation during field visits to tribal households, community gatherings (melada) and agricultural extension centres, including a Krishi Vigyan Kendra (ICAR) at Pal, Raver taluka. Plant specimens and preparation methods reported by informants were cross-verified against published ethnobotanical and phytochemical literature.

RESULTS AND DISCUSSION

Demographic Trends of the Tribal Population (1961–2011): Census data show sustained growth of the Scheduled Tribe population across the study districts between 1961 and 2011, though with district-specific patterns. In Jalgaon, the Bhil population rose steadily from 85,383 in 1961 to 375,980 in 2011. In Dhule, the Bhil population peaked at 716,021 in 1991 before falling to 438,869 by 2011, a decline attributable to the 1998 bifurcation of Dhule into Dhule and Nandurbar districts. Nandurbar itself first appears in the disaggregated record in 2001, with 714,127 Bhil, rising to 977,010 by 2011, confirming its status as a Bhil-majority district. The Kokani and Koli Mahadev communities show comparable, if smaller-scale, growth trajectories, while numerous minor tribes (e.g., Baiga, Bhunjia, Kothodi) display volatile, discontinuous enumeration across census years — most plausibly reflecting classification inconsistencies and assimilation rather than genuine demographic collapse.

The village-level survey corroborates this pattern of concentration: the Nandurbar tahsils of Dhadgaon, Taloda, Shahada and Akkalkuwa, and the Jalgaon tahsils of Yawal and Chopda, contain numerous villages with 95–100 percent Scheduled Tribe population, whereas Chalisgaon, Erandol, Sillod and Bhokardan — administratively part of the same or adjoining districts — show markedly lower and more dispersed tribal representation, generally below 40 percent. This intra-district contrast suggests differing histories of settlement, market integration and administrative attention, and points to the northwestern corridor bordering Madhya Pradesh and Gujarat as the primary reservoir of the ITK documented in this study.

Indigenous Pest Management Techniques

The field documentation outlined five main categories of indigenous pest-management practices, which are summarized below.

Botanical extracts. Most commonly used is the neech-leaf solution (from Azadirachta indica). After being hand-crunched, fresh leaves are steeped in water for approximately 1:1 and then filtered through cloth before being sprayed onto standing crops. Its effectiveness can be attributed to its combination of characteristics of Rembold *et al*.'s (1982) description, which is that azadirachtin is a potent antifeedant and insect growth regulator that has been shown to have protective effects on moult in fifteen orders of insects while also being sterile at the same time (Schroondan&Pillsby, 2006). This activity is backed up by the antifungal compounds nimbin and salanninum, which have wider medicinal and pesticidal effects as noted by Bhattacharyya *et al*. (2007).

Table 1. Geographical area and Scheduled Tribe population of the study districts (Census 2011)

District	Area (km²)	Total Population	ST Population	ST % of Total
Jalgaon	11,765	4,229,917	604,367	14.29%
Dhule	8,095	2,050,862	647,315	31.56%
Nandurbar	5,955	1,648,295	1,141,933	69.28%
Chh. Sambhajinagar	10,100	3,701,282	Minor	Minor
Jalna	7,718	1,959,046	42,263	2.16%

Table 2. Bhil tribe population by district, 1961–2011 (Census of India)

Census Year	Jalgaon	Dhule	Nandurbar	Chh. Sambhajinagar	Jalna
1961	85,383	300,099	—	24,197	—
1971	87,015	358,088	—	30,801	—
1981	141,561	531,139	—	36,835	—
1991	181,188	716,021	—	37,059	7,405
2001	251,643	295,266	714,127	46,597	8,840
2011	375,980	438,869	977,010	71,708	12,563

Informal sources claimed that it could be used to eliminate aphids, whiteflies, caterpillars and leaf miners, as well as mealybugs like powdery mildew. Botanyes of local importance include twigs from Bhelama (Anacardium skeletons) that are placed in rice fields, Calotropis leaves used for attacking caterpillars, and tobacco decoctions used to control leaf-eating insects.

Smoke and soil sterilization: The soil is sterilized during summer by the controlled burning of crop residue (jowar, bajra, cotton stalks, and vegetable waste), which kills pathogens/nematode populations, eliminates dormant weed seed,and the ash enriches the soil with potassium and trace minerals. Deep summer ploughing is commonly combined with this activity, which exposes soil-dwelling pests to solar heat and birds as a predation.

Cow-based ferments: Bio-pesticide is produced using approximately 5 kg of cow dung, 5 kilograms, and 50 grams of bovine serum. 1 L cow urine, 150 g lime and 100 grams of other substances. For 15-30 days, the L water is fermented in a shaded area with daily stirring and then sprayed to control Khaira disease and tip-burn in paddy and bacterial/viral infections in vegetable crops. The mixture not only contains pest-resistant bacteria but also provides nitrogen, uric acid and micronutrients.

An Ark based on the Dashparni legend of having ten leaves. This preparation, which is the most complex yet documented, includes ten different leaf types such as neem (asphalt apple), custard apple, and karanja. Other examples include marigold, sugar maple, tulsi, desert rice from India in Bangladesh, bael, oregano, mango husk, 2-3kg cowdung, 5-10% malted coconut oil, salt/melon, ginger root, garlic powder, etc. Note: In 200 servings, one can drink a mixture of cow urine, crushed garlic, green chilli, turmeric, and tobacco. During 30-40 days, the liquid L is fermented. A thick extract is effective in controlling the sucking insects, chewing pests, and fungal diseases, deterring predators for up to 6 months after preparation, which is a crucial practical benefit for tribal households with limited resources. According to Kasarkar *et al*. (1921), controlled laboratory trials demonstrated that Dashparni Ark's primary phytochemical components were tribal in nature, while Joshi & Sohn (2023) conducted experiments on Agrotisipsilon in Himachal Pradesh, which revealed its superior feeding-inhibition and ovicidal effects among five indigenous bioformulations, up to 1.35 times more effective than garlic-ginger-mint control.

Physical and cultural methods. To prevent the emergence of gundhi bugs, maize cobs and branches are placed in rice fields, while standing crops are lifted with ropes soaked in kerosene-water, and crop rotation or intercropping is used to break pest life cycles and maintain agro-ecological diversity.

Traditional Food Preservation: The Kangi System: Indigenous grain-storage technology, known as Kangi in the tribal community and beyond, involves large woven or earthen containers that are lined with straw and sealed with mud and cow dung to ensure airtightness, and stored in cool, shaded areas. The system safeguards staple grains like jowar, bajra, and rice from moisture, insect infestation, or fungal decay for four to six months, making it a significant but rarely researched aspect of household food security in the study area.

CONCLUSION

Based on the botanical, bovine, and mineral resources that are available locally, the tribal communities of the Satpuda and Ajanta hill ranges have an extensive Indigenous Technical Knowledge base for pest management and food preservation. In terms of geography, the Bhil tribe is the most prominent group, with Nandurbar district being its main concentration following administrative reorganisation in 1998. Non-toxic and low-cost practices like neemiah sprays, smoke sterilisation, cow-based ferments or Dashparni Ark are documented practices that are not harmful to pollinators or non-target organisms and can be used as a complement to synthetic pesticide regimes in resource-limited environments.

The case of hill-farming communities in India is supported by evidence, as demonstrated by Rathore *et al*. (2021) and Boruah ft. (2020), which suggests that many of these practices cannot be scientifically validated. The growing importance of incorporating the increasing pressures from deforestation, chemical inputs in the market, and climate variability into Integrated Pest Management frameworks and agro-environmental policy, coupled with the need to formalize and document this information as well as incorporate it into policies and practices within tribal communities, is causing urgent demands.

This is particularly important given the global biopesticide market's current valuation of nearly USD 10 billion and its rapid growth.

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