Design Intervention Through Permaculture and Social Change: Case Studies from Selected Indian Farming Sectors

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Abstract

More than 270,000 Indian cotton farmers have committed suicide since 1995, and India’s agricultural sector, which directly or indirectly employs more than 70 million Indians, faces severe crises in terms of air, water, and soil degradation, pervasive chemical-led farming, debts, and lack of a profitable and sustainable livelihood system. In addition, India is losing traditional knowledge of farming and other craftsmanship, which was more nature- and community-friendly. This has led to a loss of community identity, severe malnutrition, and loss of livelihood, leading to displacement of indigenous people. Despite governmental support, the situation has not changed significantly.

In this paper, we analyzed design and social interventions in the Indian farming sector via permaculture, which mimics relationships found in natural ecology. This design approach has a very successful history of solving the food crisis in different ecosystems across the world. Our study looks at Indian designers engaged in farming cotton and food crops in an attempt to contribute to design literature through the application of permaculture.

We measure successes in terms of three ethical parameters: care for the earth, care for the people, and return of surplus to the ecosystem. Our observational variables are design and social interventions in three Odisha communities, through interviews with designers, experts, and farmers.

We applied conceptual and relational content analysis to understand commonalities among the selected design processes and social interventions that led to better livelihoods and income for the farmers. The findings may help replicate, modify and build other thriving farming communities in India and other countries, and also invite further research in permaculture design to address social issues and influence design research and education.

Keywords: permaculture, design interventions, seed sovereignty, cotton farming

Introduction

India, the world’s fastest-growing democracy has a skewed and unequal growth path. More than 50% of the people depend on agriculture, but the farming sector is under tremendous distress (Rangarajan & Dev, 2019). The National Crime Records Bureau (2016) announced that farmer suicides in India totaled 11,379 in 2016, 12,602 in 2015, and 12,360 in 2014. About 948 Indian farmers commit suicide every month. In the area of development research and policy debates, farmers' suicides and agrarian crises took center stage (NCRB Report- Farmers Suicides, 2016). The research indicates that most framers who commit suicide are small and marginal farmers and tenants. (Rangarajan & Dev, 2019)

Researchers attribute these suicides to loss of farm income and indebtedness. Mohanty and Lenka, (2019) argue that a decline in farm income was due to rising cost of cultivation, crop loss, lack of skill and knowledge on farming, and price risks associated with agricultural markets. Land ownership by farmers, efficient cropping patterns and input use, and managing crop loss may help the farmers manage their distress. Among all types of farmers, the distress of cotton farmers is highly significant (Flachs, 2019).
Data show that the monthly income of agricultural households from cultivation remained almost constant during the last four to five years (Rs 3,081 in 2012-2013 and Rs 3,140 in 2016-2017). As per a recent All India Rural Financial Inclusion Survey, the main sources of income for farmers are cultivation, wages (as laborers), and other allied activities (NABARD, 2018).

**Cotton Production in India**

India is the second-largest producer of cotton after China. About 8.9 million hectares of India’s agricultural land (5%) is under cotton cultivation, unexpectedly consuming more than 50% of total pesticide input. More than 90% of India’s cotton is genetically modified, pest-resistant, high-yield Bt (Bacillus thuringiensis) cotton (Vithal, 2019). Bt seeds require more input costs compared to traditional varieties, which puts additional pressure on farmers. Although it guarantees high yield, the farms lack proper irrigation facilities and mostly depend on annual rains, which increases the chances of crop failure (Dhawan, 2017).

Moreover, because cash crops earn more than food crops, the small farmers invest more in cotton farming (a cash crop) than in food crops. This leads to food scarcity for the farmers’ families and leaves no alternate source of income. Thus, when crops fail, the small farmer is left with nothing but huge debts, and then committing suicide (Mohapatra & Saha, 2019; Gruère, 2011).

India is primarily a rain-fed country and small farmers mostly depend on annual rainfalls. A study revealed that micro-irrigation techniques could be used, but initial investment costs are high. Hence, very few, privileged farmers use the technique (Narayanamoorthy, 2008). While the northern states of Punjab, Haryana, and Rajasthan are almost entirely irrigated, other parts of central and south and east India like Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka, Odisha, West Bengal, and Bihar are mostly rain-fed (Ministry of Agriculture and Farmers’ Welfare, 2016).

India is also one of the most water-challenged nations as it has vast acres of agricultural lands, industries, and an ever-growing urban population, all competing for the limited surface water and groundwater resources. Also, much of India’s cotton-growing lands coincide with these high water stress areas (Vithal, 2019).

Solutions offered by the Government of India include:

- the government purchase of excess farm produce (Department of Agriculture and Farmers’ Empowerment, 2019)
- Government subsidy for chemical fertilizers and high-yield seeds. (Department of Fertilizers, 2019)
- Government-fixed pricing; however, this is lower than the market price (Commission for Agricultural Costs and Prices, 2019)
- Loans waived by government (Sud, 2009)
- Government livelihood assistance or farm support schemes like Rythu Bandhu Scheme in Telangana and Krushak Assistance for Livelihood and Income Augmentation scheme in Odisha (Rangarajan & Dev, 2019)
- Other government livelihood opportunities through the MNREGA Act 2005 (Ministry of Rural Development, 2005)

However, even after all such efforts, the problem persists due to:

- Small landholdings
- Tenant farmers not eligible for such benefit
- Water crises due to sporadic rainfall, inadequate irrigation facilities, depleting groundwater resources, and mismanagement of available water for irrigation
Poor farm planning and excessive use of Bt varieties or high yielding varieties (HYV) that require vast acreage, excessive use of fertilizers, and proper irrigation (Mohapatra & Saha, 2019; Rangarajan & Dev, 2019).

With this backdrop, we looked at organic farming and identified that it requires third-party certification to sell products as organic in the market. This cannot help the majority of farmers classified as small or marginal, or tenants. Moreover, these farmers have lower access to food crops due to the focus on cash crops. Monocropping and producing nonseasonal products also create unfortunate circumstances for marginal and small farmers (Mohapatra & Saha, 2019).

Therefore, we identified design-based solutions that could provide food security, add to income or livelihood generation, and take care of people and the environment as well. From the literature, we focused on permaculture design (Jeffrey, 2015), a nature-based design approach developed by Mollison and Holmgren in Australia almost three decades ago (Mollison, 1988; Holmgren, 2002). We also identified practitioners in Odisha who have developed food forests and agricultural designs by successfully implementing permaculture theories into practice.

This study’s research objectives are to understand the concept of permaculture design, and to study how permaculture design interventions have helped to reduce Indian agri-based crises and farmer suicides.

Research Framework and Methodology

The research is based on three permaculture designers in Odisha who have been practicing the methodologies for more than a decade. Case studies were developed for each designer by studying their websites, Facebook posts, related articles, personal interviews, and farm visits to analyze their designs and social interventions in the Indian farming sector. In our study, we considered Indian designers with at least seven years of intervention and engagement in the farming of cotton and other food crops. We measured their successes in terms of three ethical parameters: (a) care for the earth, (b) care for the people, and (c) return of surplus to the ecosystem. Our observational variables are design interventions and social interventions made by the designers in their respective communities. Apart from the observational method, we collected primary data through in-depth interviews of the designers and experts.

We collected secondary data from research papers, articles, blogs and videos, and applied conceptual and relational content analysis to understand the commonalities among the design processes and social interventions and their outcomes (Krippendorff, 2004).

Permaculture

Permaculture design is a system of assembling conceptual, material, and strategic components in a pattern that functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth (figure 1).
Permaculture is the art and science of systems thinking about people, nature, flora and fauna, and their interconnectedness. It exists all around us (Pluta, 2012). It is not agriculture or organic farming or gardening, but an ethic approach to understanding how various elements in nature are interconnected and dependent on each other for survival, and growth. Bill Mollison brought out the concept of permaculture after observing that agriculture depleted natural sources of energy like soil, biodiversity, food quality, water and air (Mollison, 1988). According to David Holmgren (2002), “Permaculture is consciously designed landscapes which mimic the patterns and relationships found in nature while yielding an abundance of food, fiber and energy for provision of local needs.”

Permaculture researchers have constructed the ethics of the system as three core values:

- Care for earth (soil, forests, water and natural diversity)
- Care for people (self, kin and community)
- Fair share (of consumption and reproduction and redistribution of surplus)
The ethical values and design principles of permaculture extends beyond landscape designing, encompassing the following domains (Mackall & Gabriel, 2012):

- Built environment
- Tools and technology
- Culture and education
- Health and spiritual well-being
- Finance and economics
- Land tenure and community governance
- Nature and stewardship

Permaculture design is based on natural ecosystems. Mollison and Slay (1991) developed a design concept based on 12 fundamental principles:

- Observe and interact
- Catch and store energy
- Obtain a yield
- Apply self-regulation and accept feedback
- Use and value renewable resources and services
- Produce no waste
- Design from patterns to details
- Integrate rather than segregate
- Use small and slow solutions
- Use and value diversity
- Use edges and value the marginal
- Creatively use and respond to change

Mollison and Slay (1991) consider these as axioms, which are self-evident truths or established principles.

In permaculture, it is essential to observe and understand the natural ecosystem and thus draw inferences to develop new ecosystems that are productive and non-polluting. By observing natural occurrences, patterns can be developed to design a holistic system. Nature absorbs and assimilates energy from one form to the other. It is the designer’s observations that help mimic nature to suit a particular situation (Holmgren, 2002).
Concrete permaculture design involves dividing landscapes into zones (of daily life: people, machines, animals, houses, and food products) and sectors (present and future energy sources, wilderness, temperature, light sources, etc.). These zones and sectors are investigated for patterns. In the end, the area used is designed to fit a few underlying patterns. (Mollison & Slay, 1991).

The designer thus observes data (patterns) and then works from the data. Mollison (1988) describe the process of permaculture design as one of assembling components to form a pattern. Permaculture focuses on learning from indigenous cultures and tribes, traditional knowledge of farming and cultivation, protection of land, water, and soil and respecting nature in its pure form.

Good design depends on a free and harmonious relationship between nature and people, and careful observation and thoughtful interaction provide the design inspiration, repertoire, and patterns. It cannot be generated in isolation, but through continuous and reciprocal interaction with the subject (Holmgren, 2002).

A pioneer of permaculture, Holmgren argues that permaculture can solve various problems of modern society. It can be applied to fields such as housing, transport, economics, or basic food growing (Ballarat, 2018).

Some important design features of permaculture are shown in figures 3 through 10.


![Figure 4. A combination of mandala and keyhole design.](https://www.interdependentweb.com/articles/rethinking-circular-keyhole-beds-and-mandala-gardens)

![Figure 5. Spiral bed design used for growing small plants and herbs.](https://permaculturenews.org/2017/03/06/garden-needs-herb-spiral-design-solution/)
Figure 6. Raised beds. http://www.ecologiadesign.com/raised-beds-on-contour-with-wood-chip-paths/

Figure 7. Raised beds capture run-off water and nutrients. http://www.ecologiadesign.com/raised-beds-on-contour-with-wood-chip-paths/

Figure 8. Plants in single beds waste space. http://frichettewinery.com/sweet-tips-red-mountain-wine-gardening/

Figure 9. Planting in spiral/curved beds can maximize space and soil. https://busy.org/@luzcypher/permaculture-principles-the-edge-effect

Figure 10. Keyhole bed vs. single rows and raised beds. https://www.interdependentweb.com/articles/rethinking-circular-keyhole-beds-and-mandala-gardens
Permaculture in India

This study is based in the Odisha state of India. The state houses 13 primitive tribes and 62 tribal communities. Odisha is in the eastern part of the country near the Bay of Bengal and has bountiful natural resources, including minerals, rivers and seas, mountains, springs, cultivable lands, and diverse forests, flora, and fauna. The main occupation of the people is agriculture with a few industries, mines, and a handloom and handicraft sector. Hence, the state has a rich traditional knowledge of farming using various techniques, tools, and methods. Despite the rich biodiversity, Odisha has also witnessed a rising number in farmer suicides in the last five years, mostly due to the inflated cost of fertilizers and pesticides, lack of indigenous seeds, low/loss of production due to natural calamities, financial losses and burdens, and poverty (Mohanty & Lenka, 2019). To counter such incidents and provide a different approach to farmers’ well-being, we discussed the following case studies, which focus on three geographically and socioeconomically different areas where permaculture is practiced.

Living Farms

Living Farms is a Bhubaneswar-based nongovernmental organization managed by Debjit Sarangi, a trained permaculturist and a sustainability fellow at the University of California. His firm works toward mobilizing more than 7000 people in 2500 Indian villages to reclaim their local food system and food sovereignty. He has been successful in designing and developing sustainable agricultural frameworks to generate appropriate solutions to address malnutrition (Terra Madre Foundation, n.d.). Their work is based on the following four pillars:

- Cultural ethos of the community
- Existing and changing agricultural patterns and use of the forest
- Symbiotic relationship of the community with the forest
- Accessibility and availability of public health services

Living farms identified that the Kondh tribes in Odisha’s Rayagada district face significant challenges in accessing food crops and forest products, mainly due to timber mafias and top-down government policies. Kondhs are one of the indigenous tribes found in Odisha, for whom the land and forests, rivers, streams, and seeds are an integral part of their identity (SCSTRTI, 2013). They practice mixed cropping and cultivate different varieties of cereals (millet, sorghum, corn, and rice), pulses, oilseeds, vegetables, and spices. But the aggressive push of intensive chemical farming and hybrid cotton farming has resulted in a rice monoculture (Choudhury & Aga, 2019; Moudgil, 2016). Other problems such as mining and industrial development have led to the decline of cultural diversity and have also increased the risk to human health (Bera, 2015).

Timber mafias were depleting the forest, and women had to walk long distances to fetch fuelwood, fruits, tubers, leaves, and other forest essentials. As a result, their children were deprived of nutritious food. Forests were vanishing, and food crops and vegetables available in local markets were full of chemical fertilizers and pesticides. Forest products played a vital role in meeting their food needs and made the local communities independent of the market (Lahangir, 2014).

Living Farms taught the tribal women about the impact of such activities and after repeated persuasion, created a team of women who took charge to protect the forests from further depletion (figures 11 and 12). They also stood against the government’s decision to plant eucalyptus as a part of a livelihood generation scheme under the MNREGA Act. The
women demanded that the government provide fruit-bearing plants that could meet the nutritional requirements of their children. Government officials finally agreed and supplied fruit-bearing plants. (Lahangir, 2014).

Rayagada is also known for cotton farming. Farmers from the indigenous communities were given the water-intensive Bt cotton seeds and other HYV seeds (figure 13). According to Sarangi, due to the erratic rainfall in these areas since 2000, cotton farming has put the farmers under huge debts due to the loss of production (Swain et al., 2019). Cotton is not only chemical-intensive and water-intensive but also promotes a culture of monocropping that deprives people of food crops and harms their health. Such incidences have led to massive debts, farmer distress, food scarcity, depletion of traditional farming knowledge, and climate crises leading to ecological shifts (Choudhury & Aga, 2019). Given the situation that prevailed in Rayagada, Living Farms took the initiative to address food crises and poverty in this area and created landscapes for paddy rice, millet, and many varieties of vegetables and fruits for the overall development of the indigenous communities (Moudgil, 2016).

To empower farmers, Living Farms created a consumer-producer group. The members were both farmers who produced organic and desi variety crops and vegetables, and consumers in the same area. To facilitate the sales and marketing of locally produced organic products, the group established a weekly market (figure 14). A unique feature of this market is fixed pricing of products that remain unchangeable for a month. The prices are based on input costs, labor, delivery and transportation charges, along with some earning over and above costs. In the weekly market, the sellers are farmers from area villages who bring their produce in baskets and sacks on bicycles or motorcycles. They offer freshly harvested vegetables, pulses, herbs, and greens, and food items central to Adivasi agriculture and diets such as nutritious millets, roots, and tubers. Consumers are strictly advised to come with bags and containers to eliminate the use of plastics (Mishra, 2019).
Advertisements for Bt cotton seeds plastered on temple walls, Rayagada (Choudhury & Aga, 2019).

Figure 14. Local market for organic products at Rayagada (Mishra, 2019).

Welt Hunger Hilfe, a German organization working on food and nutrition security, supports the initiative. Action for Sustainable Development with support from Living Farms is executing a Green College Project meant for attracting rural youth in culture and agriculture in Rayagada. The objective is to check the migration and develop a sustainable agricultural system based on traditional knowledge of the area. It is funded by Welt Hunger Hilfe and Tata Trusts, India. The green education project trains the youths by using existing natural resources (Action for Sustainable Development, n.d.).

Other projects include designing community gardens. For a farmer or a family with a small patch of land, Living Farms helps design a nutrition garden of locally grown seasonal fruits and vegetables. Such crops have a short production and consumption cycle, allowing for multiple cropping throughout the year to ensure an adequate volume of vegetables for household consumption. These gardens are crucial for improving the dietary diversity of the communities by growing a wide variety of vegetables with minimum labor, no chemicals, negligible out-of-pocket costs at a level (individual households or a group of households) appropriate for rural communities (Living Farms, 2018).

Basudha

Basudha started with 1.5 acres of land near a forest in the Bankura district of West Bengal. Basudha was established in 2002 by Dr. Debal Deb, a former officer in the government of West Bengal. His main aims were to conserve Bengal’s vanishing rice varieties, encourage and demonstrate support for organic farming and traditional methods of multiple cropping, and preserve and develop local knowledge of biodiversity and its uses. After operating for two decades in West Bengal, Deb shifted his base to Odisha.

Through Vrihi, an open-access seed bank of indigenous seeds, Basudha aims to protect India’s indigenous varieties of seeds. Since the 1990s, Deb has collected more than 1,420 native rice varieties from 12 states across India. He also collected varieties from countries like Bangladesh, Sri Lanka, Pakistan, Thailand, Korea, the Philippines, and Italy. He cultivates each of the 1,420 rice varieties on a 1.7-acre model farm, set up in the foothills of Niyamgiri hills in Odisha (Shiva et al, 2012). In the first three years of Basudha’s Odisha operation 350 varieties of indigenous paddy seeds have been distributed to more than 2000 farmers (figure 15) (Vidal, 2014).
After field experiments are conducted with local farmers who are volunteer researchers, new methods of pest control, soil management, and yield enhancement are taught to the farmers. Scientists, research scholars, students, activists, and farmers from around the world visit Basudha each year to teach, learn, and share ideas with local farmers. After six years of field testing, Deb has devised a method that allows him to plant every variety next to each other within the 1.7 acres of land while maintaining the genetic purity of each.

According to Deb, permaculture is a part of the agro-ecological movement and is the only option left for the farmers to have a safe and sustainable farming system. Basudha also focuses on the human ecology of uncultivated foods, researches and documents eco-forestry practices, preserves and develops local knowledge of bio-diversity and its usage. It is a model of ecological agriculture, with zero external inputs, not even groundwater. The farm promotes ecological architecture as well, with no kiln bricks, cement, plastics, or timber (Deb, n.d.).

**Sambhav**

An agricultural scientist, Sabarmatee, and her economist father, Prof. Radhamohan, bought about 1.5 acres of wasteland in Rohitank village, Nayagarh in Odisha. The land had no topsoil. The villagers believed that it was “asambhav” (impossible) to cultivate such lands, and thus Sambhav came into existence in 1989. Organic farming through permaculture was not widespread in India then. Starting was difficult, but through continuous experimentation, after three decades the Sambhav project has successfully cultivated 90 acres of lush green forest cover. (Figures 16-18). The hilly tracts of land were under repair for about 11 years before yielding any produce. Sambhav conserves indigenous seeds (more than 493 varieties of rice seeds) and practices climate-resilient agriculture. Seeds are given to the farmers for free as long as they sow the seeds and pass them on to other farmers. Sambhav also focuses on gender equality for farmworkers.
To conserve water throughout the year, Sabarmatee designed three ponds of different sizes and at different elevations. Rainwater is collected in the first pond and as it overflows, the water runs into the second pond. The third pond receives the excess water and forms a freshwater reservoir used throughout the year.

Prof. Radhamohan has stated that they do not stick to any particular design system like permaculture in Sambhav, but believe in ecologically sustainable agriculture. Along with his daughter, Radhamohan has successfully use the best techniques and design principles found in permaculture, and Indian traditional knowledge. Natural ecosystems are used as models to fight climate change and prepare for the unfolding climate crisis.

The farm has been able to disprove the widespread belief that indigenous varieties and organic farming reduce production. Sambhav has successfully developed a self-sustaining system that has not only established food sovereignty but converted a barren land to a lush green forest (Patnaik, Jongerden, & Ruivenkamp, 2016). Sambhav has emerged as a center of excellence in Odisha for training and research in organic farming and watershed development. Sabarmatee was awarded the Shambhavi Puraskar by the Bansidhar and Ila Panda Foundation (BIPF) (Pioneer, 2016).

**Findings and Conclusion**

Through conceptual content analysis, we found some commonalities embedded in the data collected from all the three permaculturist designers (Hsieh & Shannon, 2005). These elements include increasing biodiversity, achieving seed sovereignty, protecting indigenous seed varieties, reducing vulnerability of farmers facing natural calamities, increasing food security, bringing more land under forest cover, developing ecological balance through social interventions, improving the living conditions of marginal and/or landless farmers, and reducing dependence on external supplies. When we take into consideration the agrarian crisis and farmer suicides with data on the three permaculturists in relational content analysis (Mills, 2010), we find all these concepts are related to probable solutions to the farmers’ crises in India. From the conceptual and relational content analysis, we may conclude design interventions of these three permaculturists can successfully address food security, access to clean food, income generation, and local diversification and reduce the chance of suicide in farm communities.

The concept of permaculture design has proved successful in the face of various adversities and provides a regular, continuous source of food and livelihood. However, this design concept has not yet been included in design education in India. Hence, we argue that it is high time that design schools focus on a holistic approach toward permaculture design education, research, and practice in different fields that include farming, rural and urban
landscaping, healthcare, and product design. This nature-based design process may significantly add value to current design education and its impact on society, as well as help in creating new job opportunities for designers in this era of climate crisis. Our paper is a pioneer attempt in this direction.

References


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