BULLOCK BASED FARMING

VAAGDHARA

Resilient Strategy of Indigenous Community

2025- 26

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PREFACE

Samvad is the foundation for the cocreation of knowledge and rejuvenation of rich traditional practices, be they related to social, economic, cultural, ecological, educational, or livelihood-linked topics. Therefore, VAAGDHARA has adopted it as a key ingredient in its recipe of change, or say, the theory of change. Almost all our studies are designed and performed using the approach of Samudayik Samvad (Community Dialogue).

In Vagad regions, during July-August 2025, the majority of agriculture fields remain non-cultivated, while some of the fields started growing Kharif crops. This raised a concern, and the VAAGDHARA team started looking for reasons behind it. Initial dialogues in different Swaraj Sangathan (CBOs) indicated the importance of bullock in successful sowing during the event of extreme rains.

This led to designing this Samvad (study-dialogue), which resulted in a comprehensive study on "Bullock-Based Farming of Indigenous Community in Central-Western India." It included group-based dialogues to explore the relationship between the indigenous Bhil community and bullocks at various clusters within the junction of Gujarat, Madhya Pradesh, and Rajasthan. It also reviews their approach from the lens of sovereignty for sustainability, which is at the core of each and every action of VAAGDHARA and its community.

The study is rooted in the shared living of Bhil and Dhan (the term used by the community to describe animals). It is yet another component of the rhythms of indigenous community and their accompaniments, be it land, water, trees, and animals. I understand this study strengthens our belief in traditional indigenous systems, more so for farming systems. It will help further us for intensifying our efforts to yield more sustained benefits for underprivileged indigenous communities and society as a whole.
I extend my heartfelt gratitude to both the community who shared their experiences and members of Swaraj Sangathan and team members of VAAGDHARA who joined together to make it possible.

Jayesh Joshi

Secretary
VAAGDHARA

FOREWORD

In the modern era, more and more aspects of life and the majority of actions related to livelihoods are being mechanized and digitalized. Even in such an environment, keeping either a bull or a pair of bullocks was always a mystery for me. Being a sustainable practice facilitator, it has raised interest to explore the reasons behind it. Many a time during community dialogue we tried to get a hint, but we could not go deeper in it. Rainy season 2025, which brought an unpredictable nature of rains, created a situation where the month of July saw very few fields.
The study "Bullock-Based Farming of Indigenous Community in Central-Western India" presents collective efforts to understand how inclusion of bullocks as part of indigenous livelihoods enriches sustainable and self-reliant living for small and marginal families, even in the face of modern socio-economic and natural shocks.

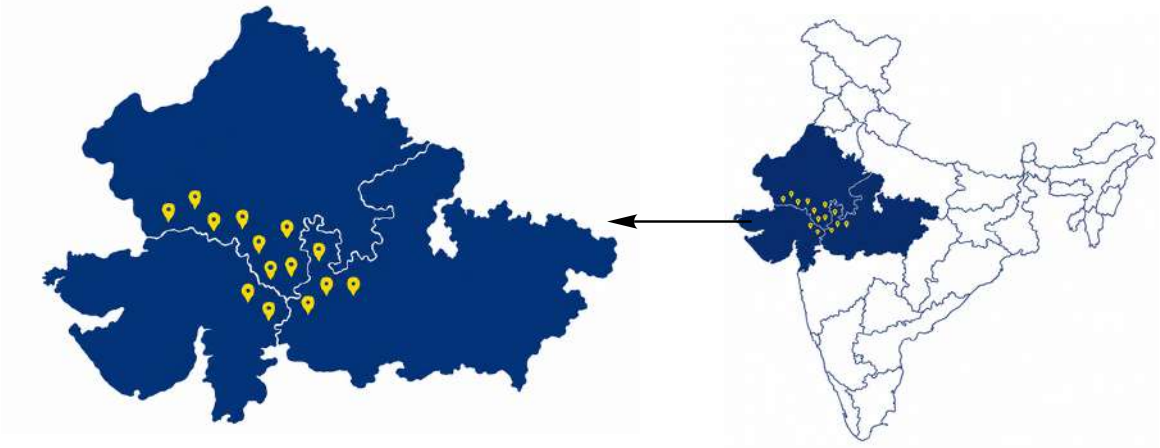
This has been a journey of joint discovery of how they relate to Dhan (animals), particularly Bail (bullock), not only as sources but also as parts of life, culture, and dignity, and sustainability with respect to climate change-induced disasters. The communities' practice of bullock-based farming shows how the traditional approach can complement the VAAGDHARA's efforts based on the core idea of sovereignty. I believe study will be useful for VAAGDHARA, the community, policy makers, and other stakeholders of community-driven models of sustainable development.

The study also sheds light on the criticality of bullock-based farming as a tool to interact between us, which has given us a foundation for a development approach that is in need of time in this complex, market-oriented global world. In such a situation, how can bullock support the approach of the local economy and traditional practice to help to withstand successfully in the event of natural calamities while reducing risks of climate change also?
The study will be useful for the revival of bullock within the village scenario and help us reduce the carbon footprint of farming, local transportation, threshing, and agro-processing, giving sustainable solutions to consistent problems. This study also laid the foundation for taking up action-research, which can further strengthen the relationship between climate-change mitigation, climate-change adaptation, regenerative approach, living income, and circular economy.

Deepak Sharma
Agro-ecological Expert

1. Context: Background of the Study

In the VAGAD region, the junction of the states of Gujarat, Madhya Pradesh, and Rajasthan, the rainy season of 2025 saw good rains in meteorological terms, but the majority of agricultural fields remained unused almost the whole of July and part of August. It looked strange; VAAGDHARA team members reflected and sought possible reasons with the community. Farmers shared that continued rains have made it difficult for tractors to enter fields, resulting in postponement of sowing. But 15-20% of fields were full of crops. How is it possible? When questioned, the answer was simple: families who have bullock pairs (Bail-jodi) could plow and sow their fields and even earn, but they rented their resources to keens and friends.



1.1 Bullock-Based Farming in the Context of Climate Variability

Smallholder agriculture in rainfed tribal geographies is increasingly exposed to climate-induced uncertainties such as erratic monsoon patterns, high-intensity rainfall events, and extended dry spells. Under such conditions, fossil-fuel-dependent mechanized farm power often becomes inaccessible due to soil moisture constraints, field fragmentation, or economic limitations. In contrast, bullock-based farming enables timely access to land preparation, sowing, and intercultural operations even during prolonged rainfall events, thereby reducing the risk of delayed cropping cycles and yield loss.

In this context, Bullock-Based Farming (BBF) may be understood not merely as a traditional practice but as a decentralized renewable farm-power system embedded within indigenous mixed farming economies.

The situation and events that followed were sufficient to give research questions like.

- Is it worth it for a farmer to maintain a pair of bulls in the present time of climate crises?
- Does it add to the economy of a small marginal farmer? What is there from the farmer's perspective?

1.2 Rationale for Revisiting Bullock-Based Farming:

Over the past decades, agricultural development pathways have largely focused on mechanization and external-input-dependent farming systems. While such transitions have contributed to productivity enhancement, they have also increased dependence on fossil fuels, reduced on-farm nutrient recycling, and weakened crop–livestock integration. This has raised concerns regarding ecological sustainability, farm-level economic viability, and climate resilience of small and marginal farming households in rainfed regions.

Innovation in farming has helped India transform from a food-begging nation to a food-surplus nation. These innovations centered on the mechanization of agricultural practices and large-scale usage of chemicals. Though the Green Revolution has helped increase food production, it has taken away the quality of our produce. It has done tremendous damage to our environment and also to native biodiversity. Our farmers had been cultivating crops for sustenance using traditional practices even before the Green Revolution.

All these aspects point towards the importance of bulls in the lives and livelihoods of indigenous but traditional families, but these days the lens of economics asks whether keeping a pair of bulls for 365 days to get work for 20-25 days only, that too, can be managed through payment of a small sum. This discussion asked VAAGDHARA to institute a quick survey with its community to explore in-depth. Specific questions for the study:

- How do bulls impact the economy of the small and marginal and overall community?
- What is the impact of bulls on ecology?
- Do bulls have socio-cultural importance for indigenous communities?
- How compatible is bull-based farming with modern-day concepts of circular economy, carbon footprint, climate change resilience, and mitigation?

1.3 Bullock-Based Farming as Renewable Farm Power

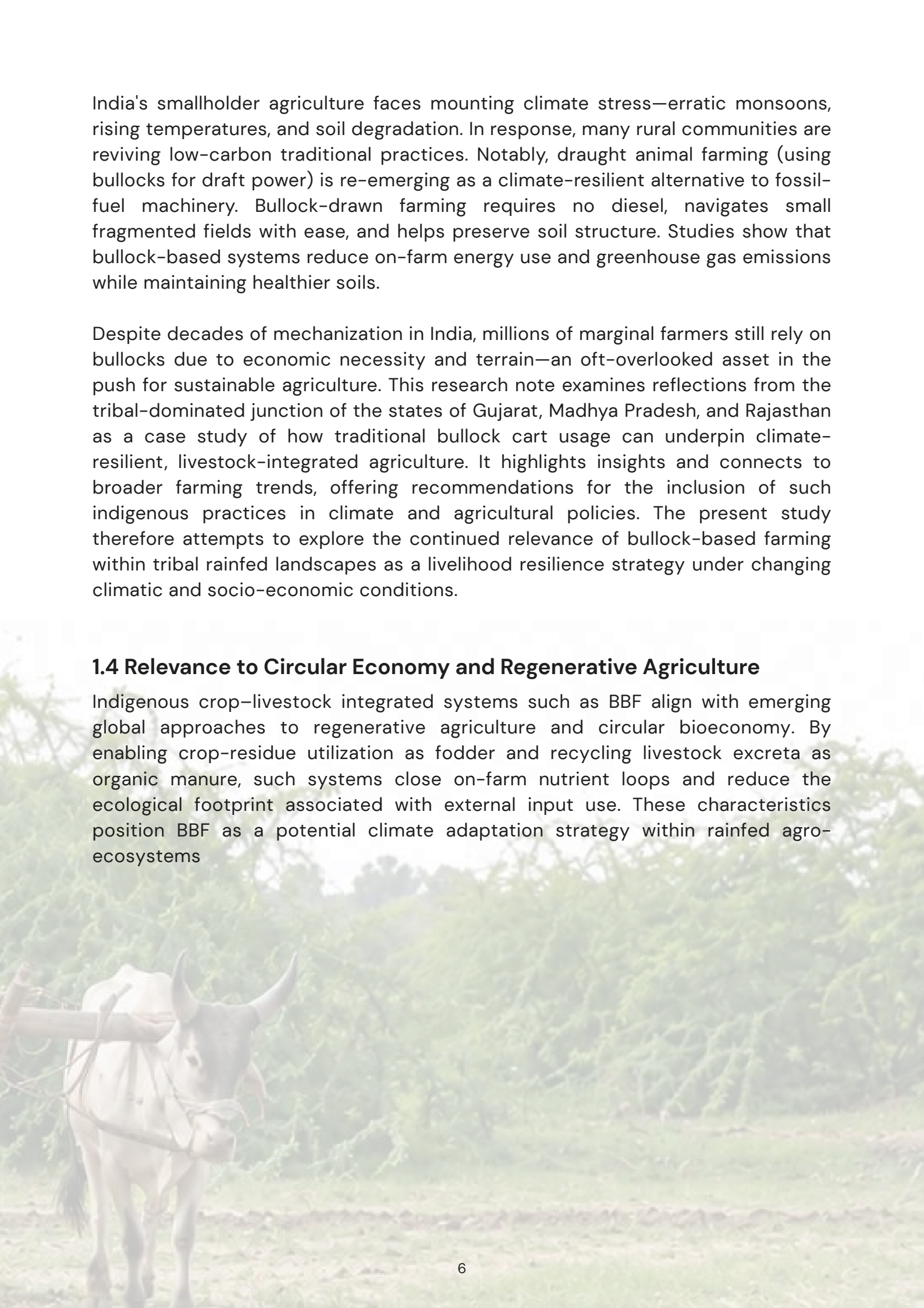
Draught Animal Power (DAP), when integrated within smallholder farming systems, functions as a locally governed renewable energy source for agricultural operations such as ploughing, sowing, interculture, and short-distance transport. Unlike mechanized systems, BBF does not rely on diesel or electricity and is compatible with undulating terrain, black cotton soils, and small fragmented plots. The integration of livestock within cropping systems also strengthens circular nutrient flows through manure and urine application, thereby reducing dependence on synthetic fertilizers.

India's smallholder agriculture faces mounting climate stress—erratic monsoons, rising temperatures, and soil degradation. In response, many rural communities are reviving low-carbon traditional practices. Notably, draught animal farming (using bullocks for draft power) is re-emerging as a climate-resilient alternative to fossil-fuel machinery. Bullock-drawn farming requires no diesel, navigates small fragmented fields with ease, and helps preserve soil structure. Studies show that bullock-based systems reduce on-farm energy use and greenhouse gas emissions while maintaining healthier soils.

Despite decades of mechanization in India, millions of marginal farmers still rely on bullocks due to economic necessity and terrain—an oft-overlooked asset in the push for sustainable agriculture. This research note examines reflections from the tribal-dominated junction of the states of Gujarat, Madhya Pradesh, and Rajasthan as a case study of how traditional bullock cart usage can underpin climate-resilient, livestock-integrated agriculture. It highlights insights and connects to broader farming trends, offering recommendations for the inclusion of such indigenous practices in climate and agricultural policies. The present study therefore attempts to explore the continued relevance of bullock-based farming within tribal rainfed landscapes as a livelihood resilience strategy under changing climatic and socio-economic conditions.

1.4 Relevance to Circular Economy and Regenerative Agriculture

Indigenous crop–livestock integrated systems such as BBF align with emerging global approaches to regenerative agriculture and circular bioeconomy. By enabling crop-residue utilization as fodder and recycling livestock excreta as organic manure, such systems close on-farm nutrient loops and reduce the ecological footprint associated with external input use. These characteristics position BBF as a potential climate adaptation strategy within rainfed agro-ecosystems



2. Bulls in Ancient India

The integration of draught animals within agricultural production systems in the Indian subcontinent has historically been rooted in ecological adaptation and resource optimization across diverse agro-climatic regions. Nandi is the well-known religious creature associated with the lord Shiva, one among the trinity. It is not only the transport vehicle but also known as one of the closest disciples of Shiva. The Sanskrit name of the bullock is Vrishabh, which is referred to in almost all Vedic scriptures, reflecting their importance in the life and livelihoods of that society. Beyond their socio-cultural symbolism, bullocks historically served as primary sources of farm energy for land preparation, irrigation, threshing, and transport within subsistence-oriented agrarian economies.

Their integration within farming systems enabled efficient utilization of crop residues as fodder and facilitated the recycling of livestock excreta as soil amendments, thereby contributing to long-term soil fertility management.

In the Indus Valley civilization during the Harrapan era, bullocks were also symbols of prosperity, and one can find a famous seal dedicated to the Tharparker breed, believed to have flourished across the Thar desert of present day.
Archaeological evidence from early agrarian settlements indicates the use of animal traction for tillage and transportation, reflecting the evolution of mixed crop–livestock farming systems that minimized reliance on external inputs and sustained productivity through locally available biological resources.

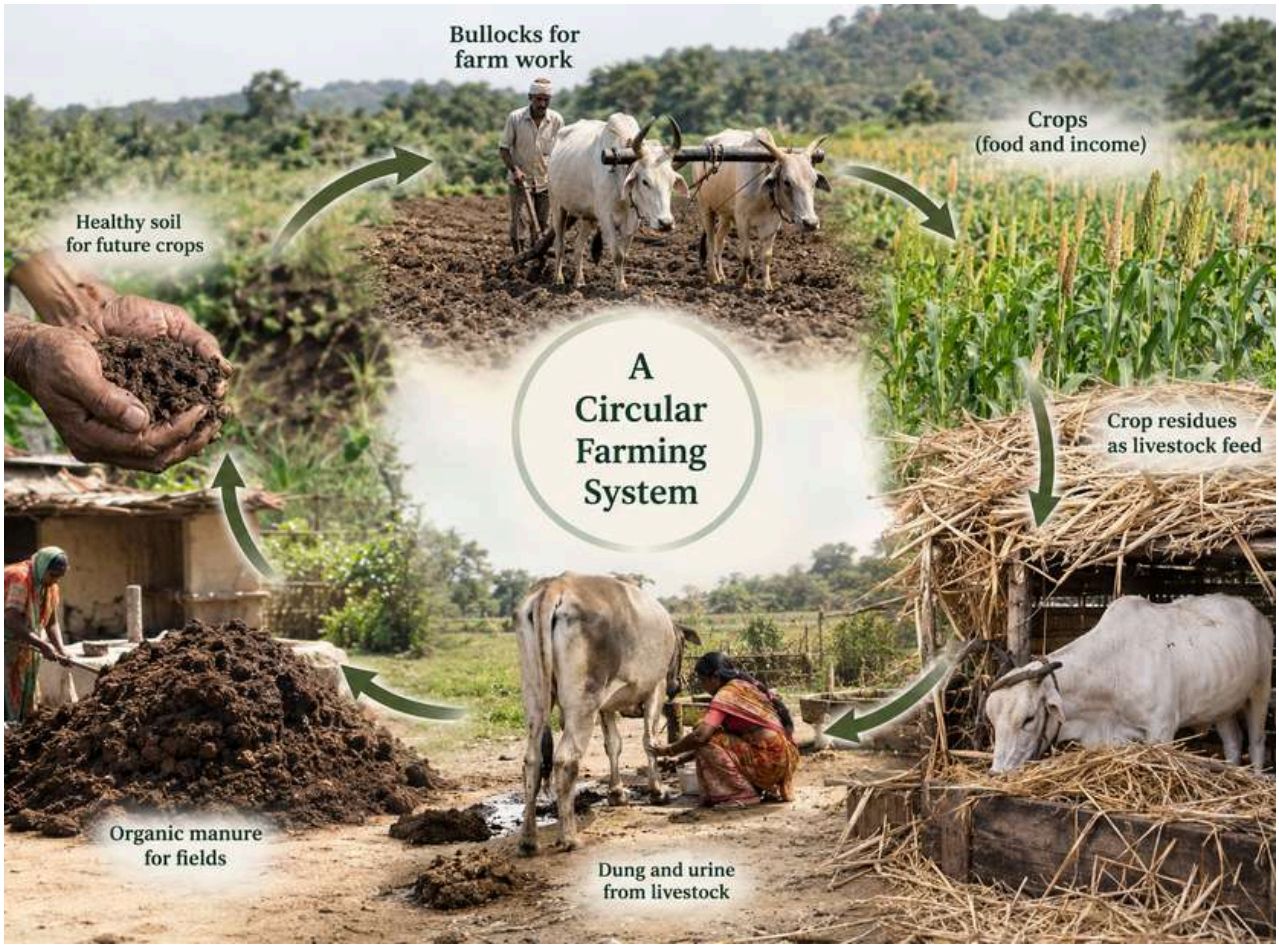
Archaeological evidence shows that our ancient civilizations, like the Indus Valley Civilization (around 3300–1300 BCE), practiced agriculture, as evidenced by findings of farming tools, irrigation systems, and crops like wheat, barley, and cotton. The use of canals, reservoirs, and well-planned drainage systems for irrigation and water management, attested by archaeology.

2.1 Traditional Mixed Farming Systems as Circular Economies

Historically, smallholder farming systems across the Indian subcontinent functioned as closed-loop production units where livestock played a central role in maintaining ecological balance. Crop residues were utilized as feed for draught animals, while dung and urine were returned to fields as organic manure. This cyclical flow of biomass and nutrients reduced the need for inputs and supported sustainable agricultural production over generations.

Contemporary approaches such as regenerative agriculture and agroecology emphasize soil health restoration, on-farm nutrient recycling, and reduced dependence on fossil-fuel-driven mechanization. These principles closely align with traditional mixed farming systems historically practiced by indigenous communities, wherein draught animals formed an integral component of agricultural production and rural livelihoods.

Understanding this historical integration of livestock within farming systems provides important insights into the potential role of bullock-based farming as a climate-resilient and resource-efficient production strategy in present-day rainfed agro-ecosystems.



3. Bullocks and Present-day Situation

In contemporary smallholder farming systems, agricultural operations are powered through a combination of human labor, draught animal energy, and mechanized inputs. However, access to mechanized farm power remains constrained for small and marginal farmers due to fragmented landholdings, undulating terrain, limited capital availability, and increasing cost of fossil fuels. Under such conditions, draught animal power continues to function as an accessible and locally managed source of renewable farm energy. From prehistoric times when man changed status from hunter-gatherer to settled agriculturist, he harnessed the muscle power of large domestic animals to augment his own physical efforts in food production and leisure. Nowadays in any agricultural crop production system, humans, draught animals, and engines or motors provide the motive power in various proportions for crop production, harvesting, transport, and processing. Animals continue to be a major source of motive power of India and are used by the majority of the small farmers. Draught animal power (DAP) is a classic example of large-scale application of appropriate technology concepts to millions of small and marginal farmers for cultivation and small-scale transportation. Particularly in rainfed tribal regions, bullock-based farming supports timely farm operations during peak agricultural seasons when delays in ploughing or sowing may adversely affect crop productivity. The ability of bullocks to operate in wet soil conditions and on sloping lands enables farmers to initiate agricultural activities even during prolonged rainfall periods when mechanized equipment becomes unsuitable.

Agriculture cannot be completed without the mention of animate power for the farm. This might be the reason for getting placed in our Vedas and Samhita, which represent the happiness and prosperity of the society and people. Livestock populations were 536.752 million in the year 2019, while backyard and commercial poultry were 317.07 and 534.74 million, respectively. Out of the 536.752 million livestock population, the population of draught animals (bullocks and buffaloes) is 33.44 million. Despite the expansion of agricultural mechanization, the continued presence of draught animals across smallholder farming systems indicates their functional relevance in regions where terrain, soil conditions, and farm size limit the economic feasibility of tractor-based operations.

3.1 Bullock-Based Farming and Farm Energy Access

Mechanized agriculture depends heavily on diesel and electricity, which increases production costs and exposes smallholder farmers to fluctuations in energy prices and supply disruptions. In contrast, bullock-based farming relies on biological energy derived from locally available biomass in the form of crop residues and grazing resources. This makes draught animal power less vulnerable to external market shocks and contributes to greater operational autonomy at the farm level.

In 1961 the contribution of the draught animals to the total energy requirements of the farming system was 71 percent; by 1991 this had come down to 23.3 percent. Almost all operations other than land preparation switched over to electrical and mechanical sources of power; even ploughing of land is progressively being brought under mechanization. According to the latest livestock census, India has over 30 million bullocks employed as draught animals, which is almost half the number used in 1997. However, ploughing and tilling of land to a very large extent are still draught animal based even where ploughing and tilling operations are carried out with tractors; other operations like interculture and seed drilling are almost exclusively carried out with work bullocks.

Bullock (Zebu cattle) and buffalo are major sources of draught animals in India. The castrated male cattle over three years of age (2.5 years in crossbred) are used as draught animals—classified as 'animals for work.' From 1961-62 to 1991-92, the population of working bovine has reduced from 77.81 to 77.69 million, registering negative growth of 0.20% per annum. The cropping season generally lasts for only some 30 days during Kharif and 30 days during Rabi, or a total of 60 days in a year. 70 million bullocks are exclusively used over 60 days for cultivation, 6 hours each day, accounting for a total power output of some 9450 million KWH or power units. Work animals are used only for 100 days in a year for all purposes together (cultivation and transportation). Their total work output for the 100-day period. The average working year for a work bullock would be 15750 million KWH or units.

3.2 Integration within Crop–Livestock Systems

Bullock-based farming is intrinsically linked to mixed farming systems where livestock and cropping activities complement each other. Crop residues serve as fodder for draught animals, while dung and urine are utilized as organic inputs to maintain soil fertility. This integration reduces reliance on external fertilizer inputs and strengthens circular nutrient flows within the farm ecosystem. While draught animals may be engaged in direct agricultural operations for limited periods during the cropping season, their indirect contributions through manure production, transportation, and rental services provide additional economic and ecological benefits throughout the year.

On the basis of coverage of land, one bullock pair can cultivate some 0.33 ha in a 6-hour working day. Increased farm power needs will be for increased irrigation, exclusively met from electrical and mechanical sources even today. Therefore, very large wastage of potential in the DAP system can be contributed to the following reasons.

1. Underutilization and misuse of animals
2. Injurious and less efficient harnesses
3. Poor feed and lack of health care coverage
4. Poor design of implements resulting in inefficient work-draft conversion.
5. Use of inefficient traditional animal carts
6. Improper management of DAP.

The declining utilization of draught animal power in many regions may therefore be attributed not only to technological limitations but also to institutional challenges such as reduced availability of grazing commons, limited access to veterinary services, and absence of locally appropriate implement innovations. Given these operational and ecological advantages, understanding the present-day role of bullock-based farming in sustaining smallholder livelihoods under changing climatic and economic conditions becomes increasingly important.

4. Study Design Methodological Approach

The study followed an exploratory field-inquiry approach to understand the functional, ecological, and economic relevance of bullock-based farming within indigenous smallholder agricultural systems in rainfed tribal geographies. The study adopted a qualitative research design to capture community-level perceptions regarding the role of bullock-based farming in sustaining agricultural livelihoods. Group-based discussions were conducted with organized community institutions such as Saksham Samuh and Gram Swaraj Samuh across selected villages to understand the operational use, perceived benefits, and challenges associated with maintaining draught animals for agricultural purposes.

4.1 Sampling Framework

A purposive sampling approach was adopted to ensure representation from tribal-dominated rainfed farming systems across the tri-junction region of Rajasthan, Madhya Pradesh, and Gujarat. One representative village was selected from each of the fourteen blocks across six districts where VAAGDHARA has ongoing community engagement.

4.2 Data Collection Tools

A purposive sampling approach was adopted to ensure representation from tribal-dominated rainfed farming systems across the tri-junction region of Rajasthan, Madhya Pradesh, and Gujarat. One representative village was selected from each of the fourteen blocks across six districts where VAAGDHARA has ongoing community engagement.

Data for the study were collected using structured Focus Group Discussion (FGD) tools designed to document community perceptions on:

- Agricultural operations involving bullocks
- Duration and frequency of usage
- Livelihood contributions
- Feed and fodder arrangements
- Availability of associated implements
- Economic and ecological benefits
- Challenges in maintaining bullock pairs

4.3 Data Analysis Approach

The responses obtained during group discussions were collated and analyzed using descriptive statistical methods to identify patterns related to bullock ownership, usage across agricultural operations, and perceived livelihood benefits within the study geography. Considering the need to explore the community perception towards a pair of bulls and its importance in the life and livelihoods of indigenous traditional families, a study was undertaken. Keeping in mind the modern-day lens of economics, “whether keeping a pair of bulls for 365 days to get work for 20-25 days only is worth it? Thus, the study initiated by VAAGDHARA to interact with the community and jointly explore the following research questions.

- How do bulls impact the economy of the small and marginal and overall community?
- What is the impact of bulls on ecology?
- Do bulls have socio-cultural importance for indigenous communities in Indian society?
- How much bull-based farming is compatible with modern-day approaches like circular economy, carbon footprint, regenerative, climate change resilience, and climate change mitigation?

4.4 Preliminary Discussion

Initial discussion with representatives of KASS brought out the following perceptions of indigenous farmers, which created the basis for this study, i.e., “Is it worth having a pair of bulls as a resilient strategy and sustainable economy?"

- Bail (bull) is more than an asset; it is a partner in livelihood. It ploughs the land, carries goods, provides manure, and supports rituals and cultural identities.
- Bail (bull) represents strength and energy.
- It gives a foundation of the Circularity within the village economy, as it is there to fulfill the demand of power, manure, crop-residue management, and optimizing use of commons (forest and pastures).
- It makes agriculture sustainable by adding to soil’s health and biodiversity.
- Protecting Livelihoods and Social Dignity.
- Among tribal families, bulls are part of cultural and spiritual living, festivals, rituals, and folk traditional celebrations, and a sign of respect for all living beings.

4.5 Sample Survey

To explore the bullock linkages, discussions were held with farmers' groups at one village each in fourteen blocks in five districts of the states of Gujarat, Madhya Pradesh, and Rajasthan. Altogether 319 participants contributed to the study (168 men and 151 women). The inclusion of both male and female participants enabled the

study to capture gender-differentiated perspectives on livestock management, agricultural labor contribution, and farm-level decision-making related to draught animal utilization.

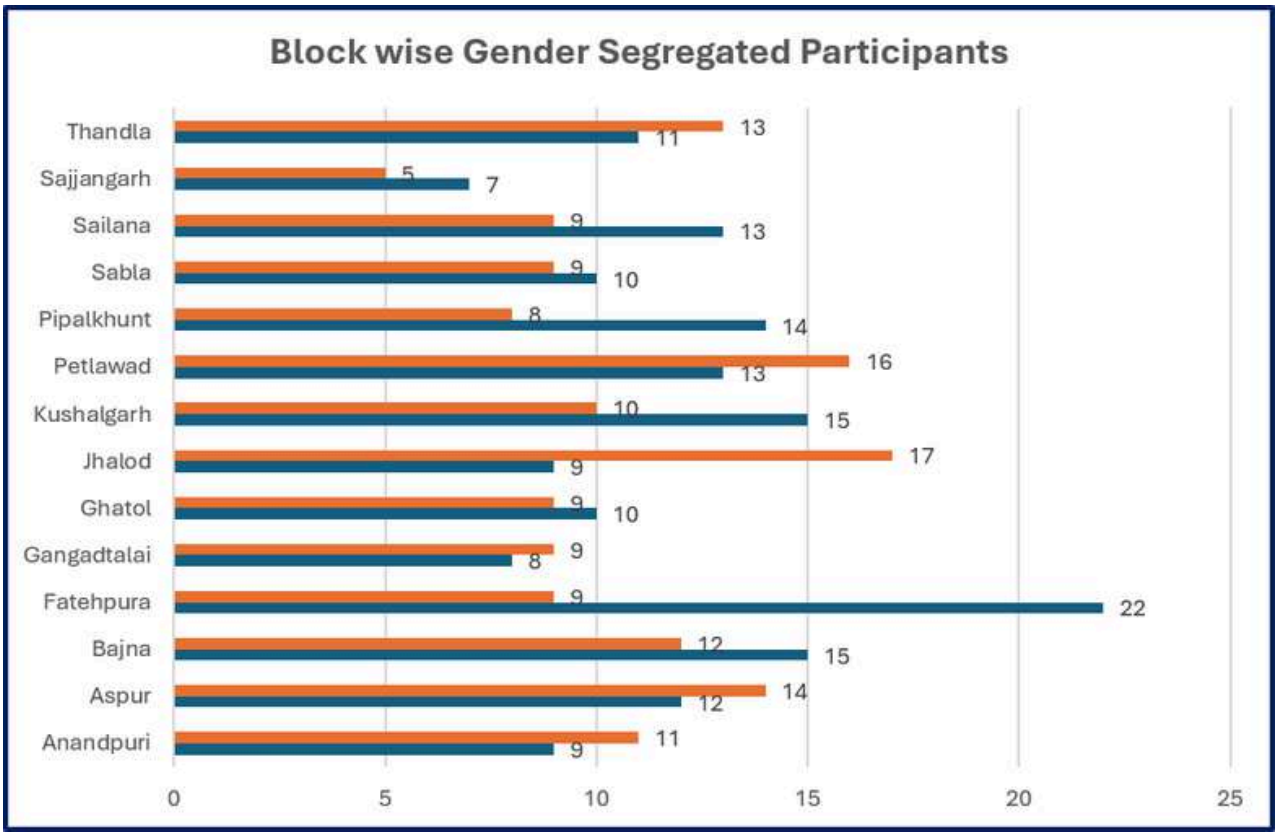


Figure 1: Blockwise Sample Number and Gender Segregation

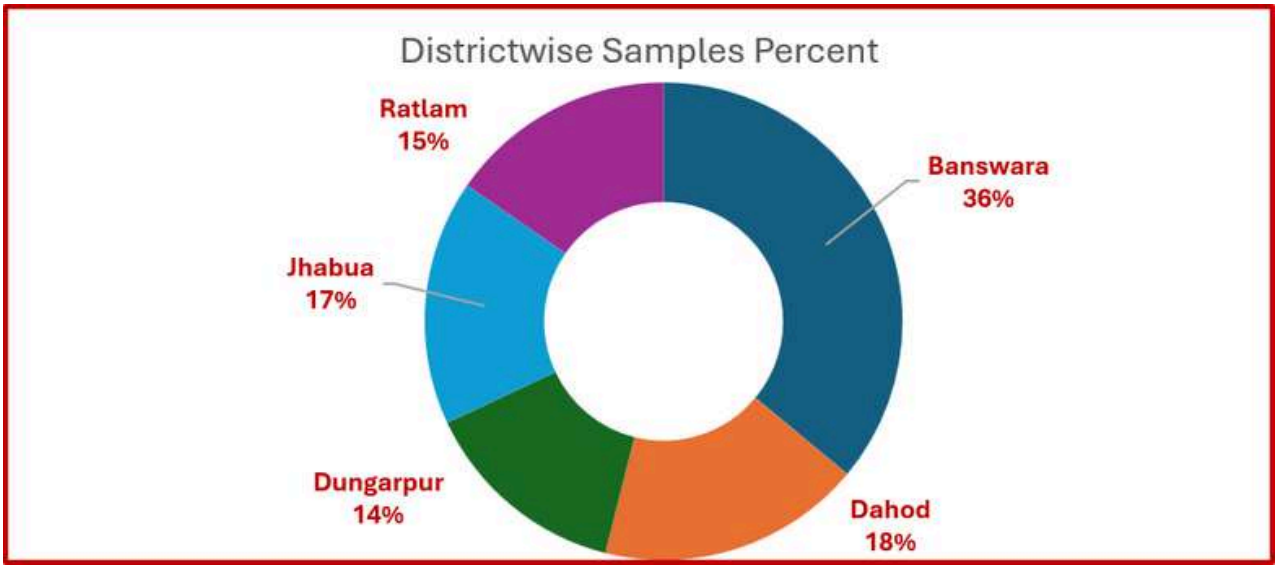


Figure 2: District-wise Sample Percent Participated in study

As shown by Figure 2 in this study, the majority of participants were from Rajasthan (50%, Banswara-36% and Dungarpur-14%), while 32% of participants were from two districts of Madhya Pradesh. Gujarat was represented by 18% of participants from the Dohad district. Further analysis indicates that the participant families have limited flat

land, with only 31% of respondents, while other categories of land are undulating and with moderate to steep slopes. (Figure-3)

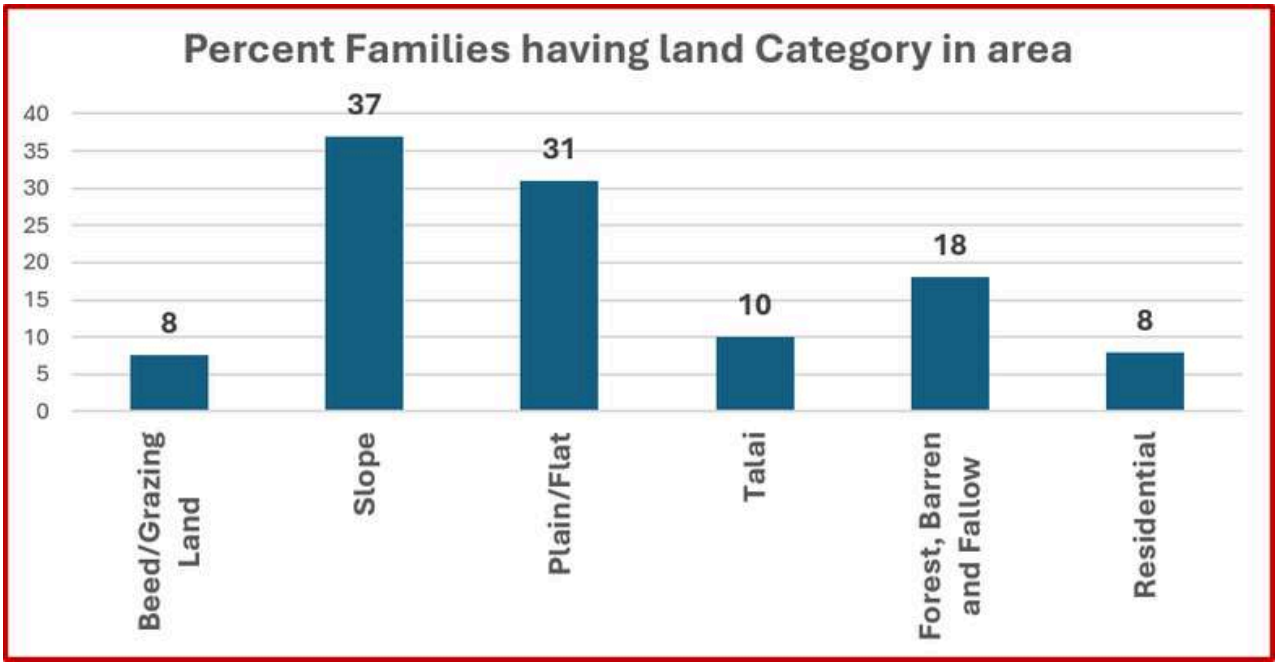


Figure 3: Land Category and Respondent family's percent

Figure 4 indicates that among indigenous community animal husbandry for the majority of small and marginal farmers. Among participants' responses, 76% reared goats, followed by 69% rearing Bullock and 58% rearing cows.

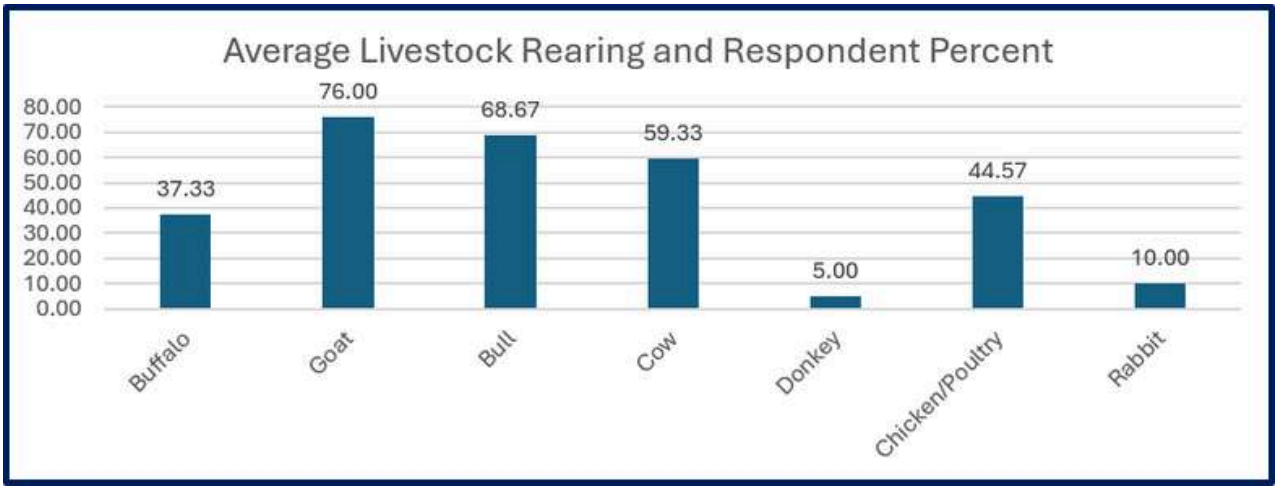


Figure 4 Percent Respondent Families and Livestock Component in livelihood

Further, the samples from representative villages in various blocks indicate that 100 percent of the participants at the Bajna, Kushalgarh, Sabla, and Sajjangarh blocks own bullocks. Among Petlawad blocks, participants' only 30% samples own bullocks (Figure-5), sharing block-wise findings.

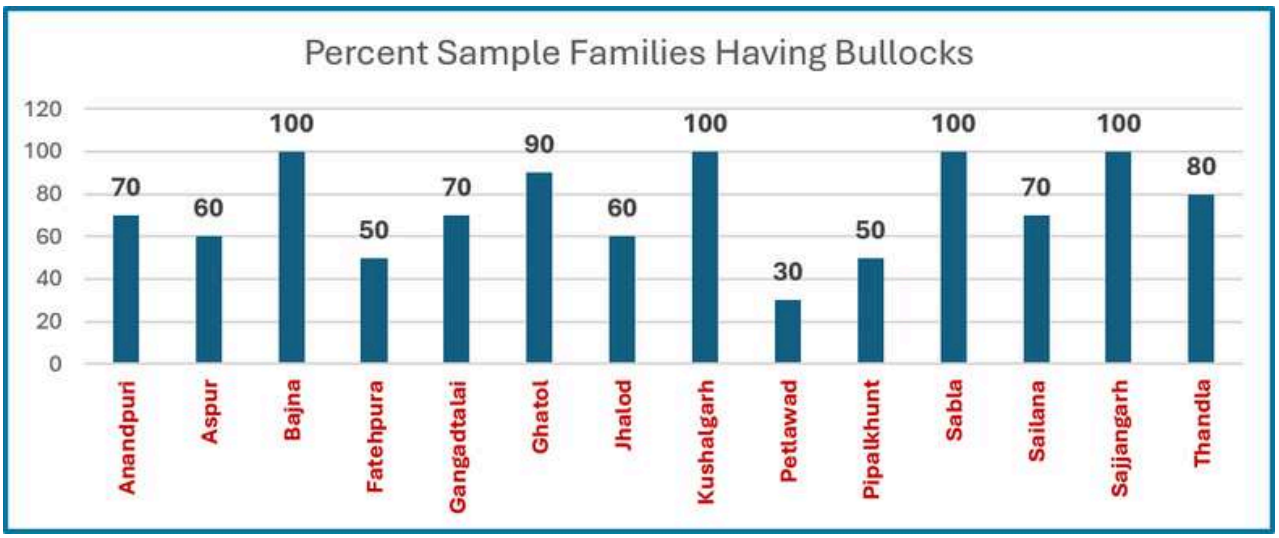
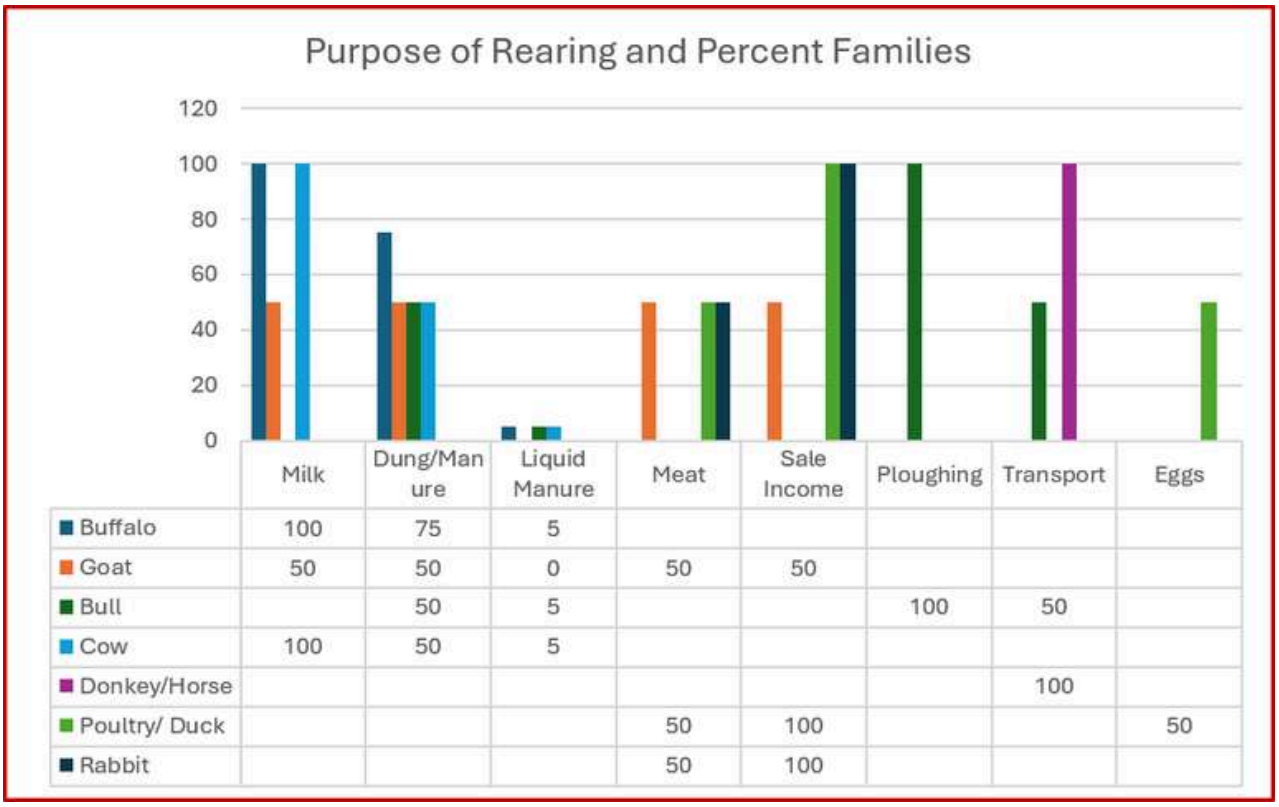


Figure 5: Bullock Ownership Percent



	Milk	Dung/Manure	Liquid Manure	Meat	Sale Income	Ploughing	Transport	Eggs
Buffalo	100	75	5					
Goat	50	50	0	50	50			
Bull		50	5			100	50	
Cow	100	50	5					
Donkey/Horse							100	
Poultry/ Duck				50	100			50
Rabbit				50	100			

Figure 6: Percent of families who shared purpose of bullock rearing

4.6 Limitations of the Study

As the study is based on perception-based responses obtained through group interactions, the findings primarily reflect experiential knowledge of community members rather than quantified farm-level economic measurements. Further research involving detailed cost–benefit analysis may be required to estimate the economic efficiency of bullock-based farming systems in comparison with mechanized alternatives. Despite these limitations, the study provides valuable insights into the continued relevance of indigenous crop–livestock integrated systems in enhancing livelihood resilience within rainfed tribal agro-ecosystems.

5. Study Findings

The study moves around the findings related to the factors that are associated with the bullock rearing and livelihoods. It is based on the group interviews within Saksham Samuh and Gram Swaraj Samuha organized at fourteen villages for six tribal-dominated districts of three states. The findings are presented with reference to the following aspects.

5.1 Geographic Factor

Figure 7 tries to establish a relationship between land category (sloping land) and the percent of families having bullocks. In almost all the villages where more than 50% of families have sloping lands, the percentage of families owning bullocks is above 70%. Fatehpura and Jhalod blocks of Gujarat representation indicate that even they have flat land, but due to thick zones of black cotton soil, they keep bullocks so as to ease ploughing operations and even transport within the village. This is also confirmed by participants from Kushalgarh, Sajjangarh, and Bajna, who said that bullock-operated implements help them in timely farming practices like ploughing, sowing, and intercultural operations even in the events of continued rains.

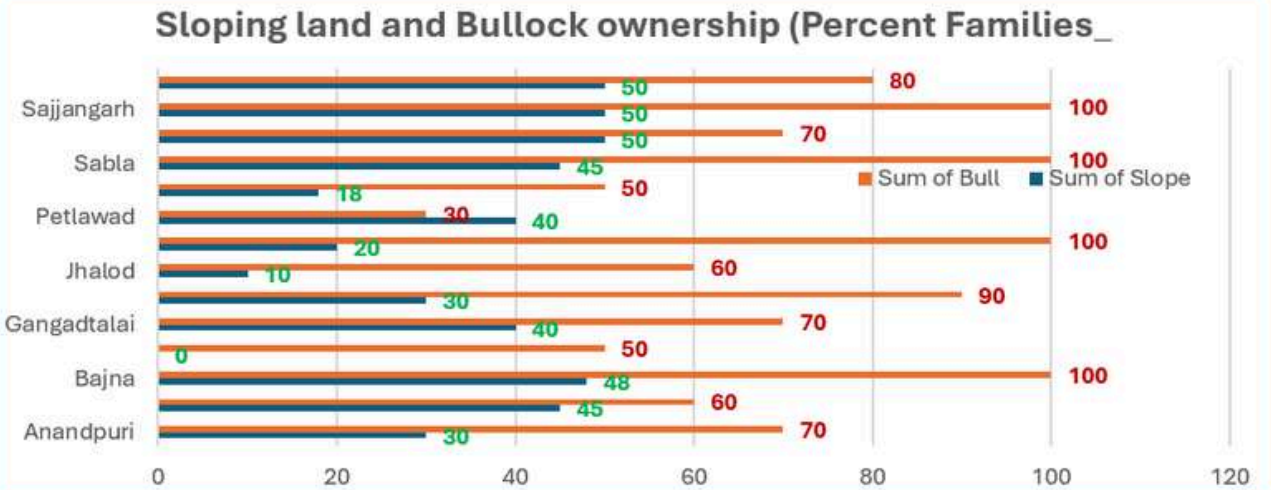


Figure 7 Relationship between sloping land percent and percent farmers families have bullocks

5.2 Livelihood Factor

The families who own bullocks were asked to respond to the kind operations they involve bullocks. One hundred percent of respondents indicated ploughing, levelling (Patia), sowing, and weeding. Seventy-three percent of respondents do use bullocks in local-level transport, i.e., from field to house and rarely to nearby markets. Nearly 87% of families do share [1] or rent their bullocks to relatives and neighbors.

[1] A good number of smallholders who owns only one bullock; thus, they share with other families who also own one so as to complete the pair.

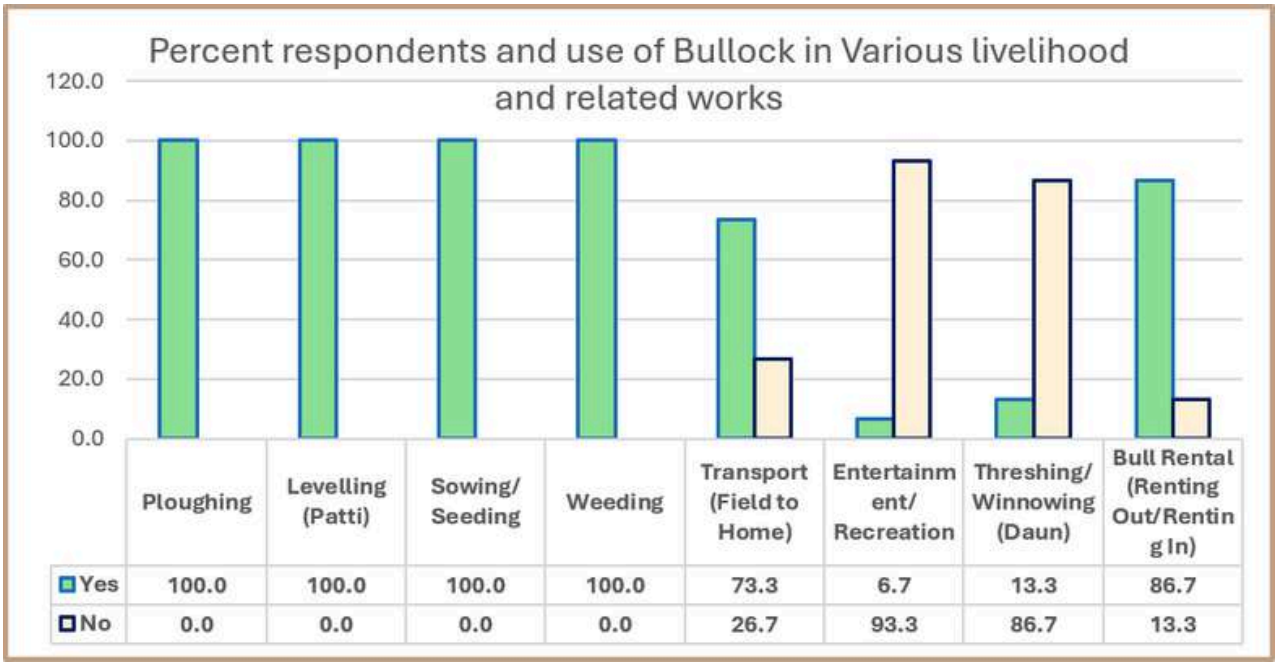


Figure 8 Involving bullocks in various farming operations

Ploughing

Leveling

Transportation

Threshing

Though earlier majority of families involved bullocks in threshing also, now less than 14% families use bullock-powered threshing.

In various parts of the country, bullocks are also involved in recreation activities, and they do have some cultural importance for the community. Almost all (93.3%) participating families were not able to recall use of bullocks in entertainment activities such as bullock runs, bull fights, bullock cart races, etc.

Culture importance

Bullock-cart race

5.3 Time and Produce Factor

In response to the question of the time-involvement of bullocks in farming and other related activities, participants indicated the majority of families use bullocks for an average of 36 days in ploughing, sowing, and removal of weeds. Use of bullock in transportation is limited except for a few families using them for transporting crops and fodder from fields to home.

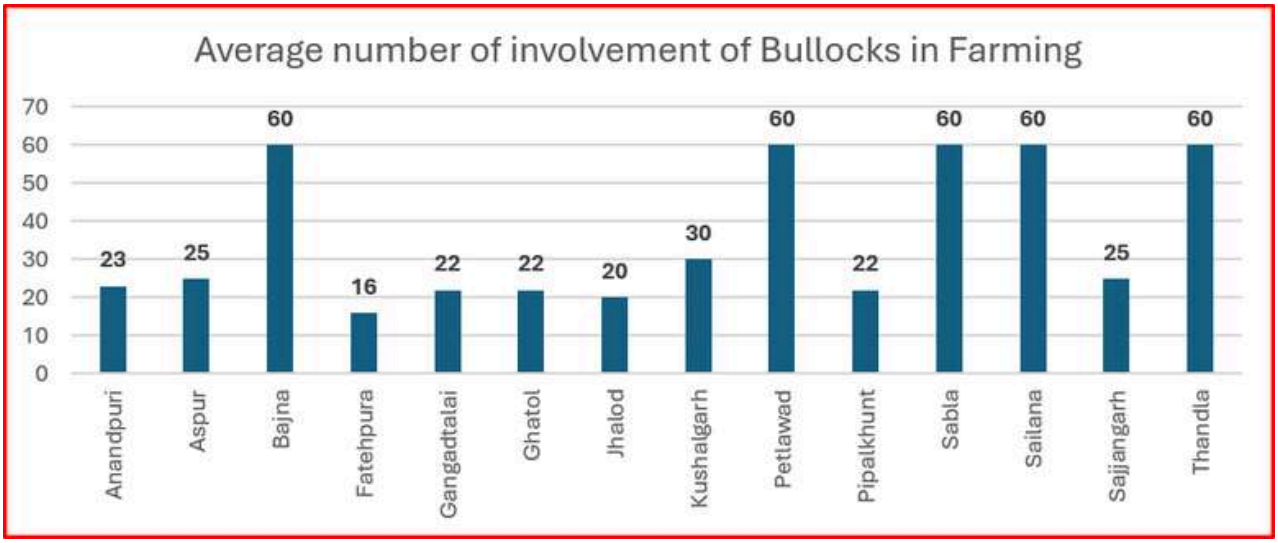


Figure 9: Percent of families indicating use of bullocks as perceived as now

Bajna, Petlawad, Sabla, Sailana, and Thandla blocks have shown a maximum of 60 days (16.44% time in a year), Kushalgarh (30 days) and other blocks shows using bullocks less than 25 days with Fatehpura participants as least user, i.e., 16 days only.

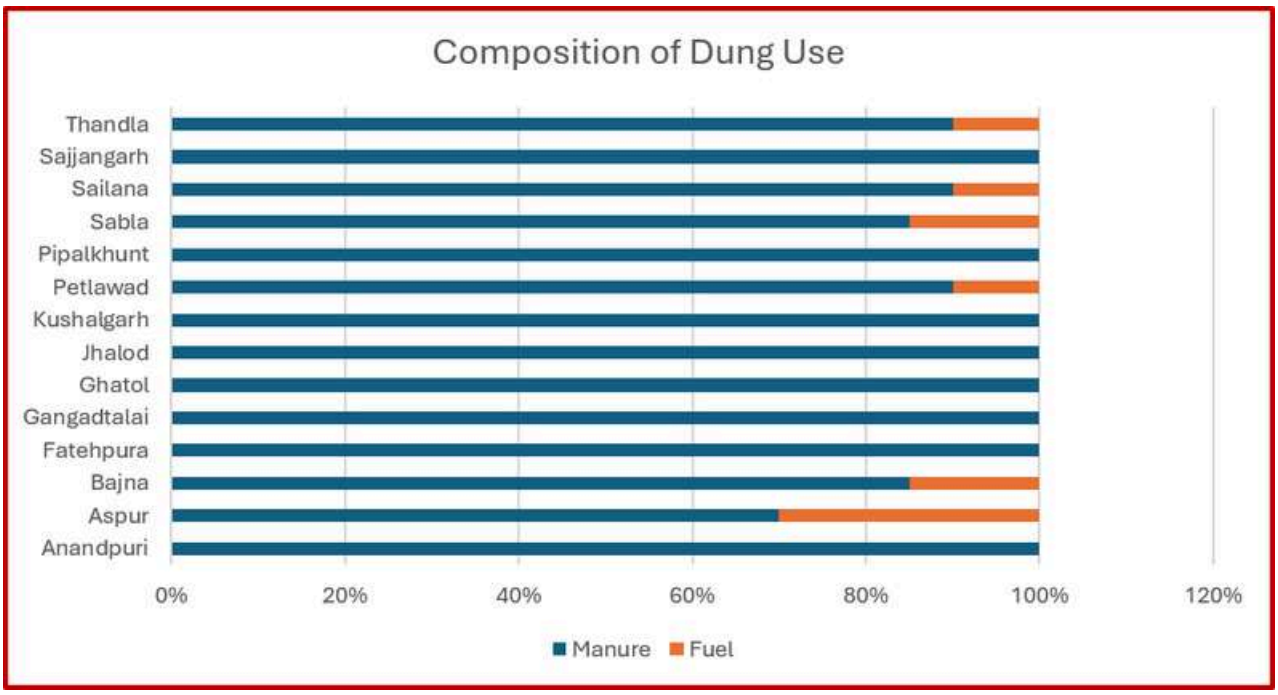


Figure 10 Percent Families indicated use of bullocks within various operations within livelihoods and living

Participants further indicated that another benefit they get from the presence of bullock is the amount of urine and wet dung, on average 15-20 liters of urine and 10-15 kg of wet dung daily. It helps in adding to the manure store of the farm. In different blocks, the pattern of use of dung is shown in Figure 10, which shows that most people use dung as farmyard manure except for participants from Aspur, who also use dung as fuel in the form of dried-dung cake (Upla and Kanda) up to 30%. Thandla, Sailana, Sabla, and Petlawad farmers also put 10-15% as fuel.

5.4 Feed and Fodder Factor

Figure 11 shares the annual fodder management style of the majority of participants, which indicates wheat-straw and grass as major sources during summer and winter. During monsoon they are able to provide green fodder. No specific fodder is separately arranged by bullocks except a few days in advance; before ploughing, they are provided some additional quantity and some form of protein diet. Few families do give them mahua leaves during summer and palash leaves during winter; they fulfill additional energy requirements during the working period.

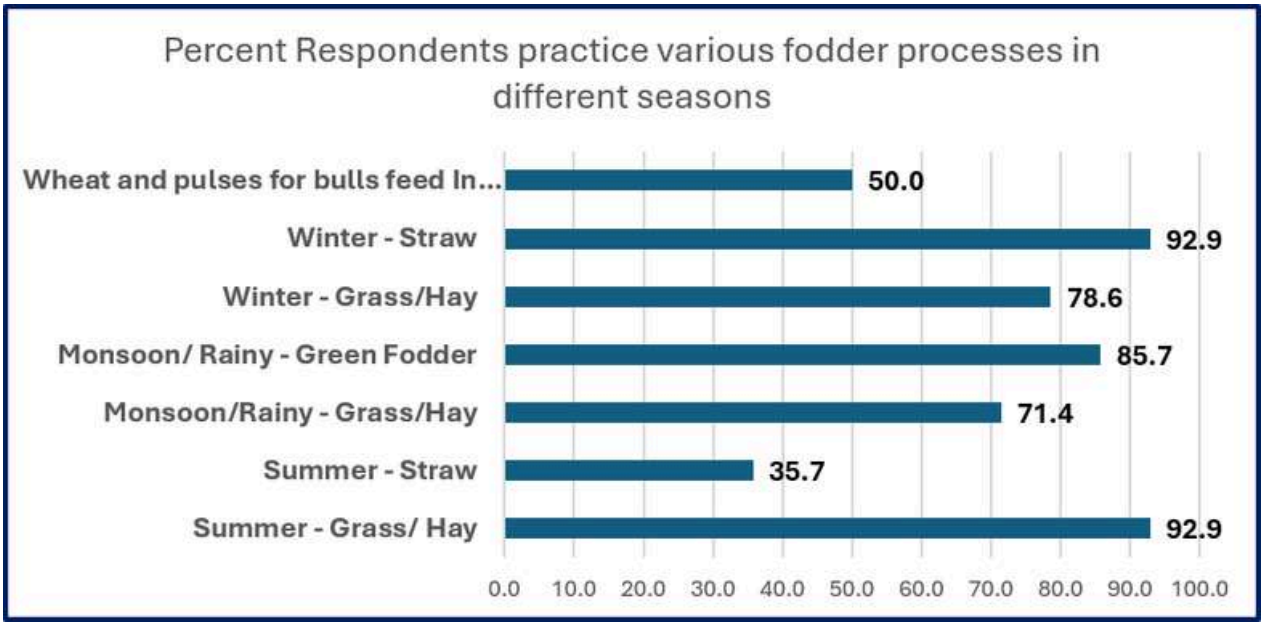


Figure 11 Percent Respondents and seasonal fodder management

Mahua Leaves

Palash Leaves

5.5 Associated Implement Factor

Participants also indicated that almost all families who have a pair of bullocks, or even one bullock, have associated tools such as Hal (ploughing), bakhhar (harrow), Kalpa (weeding tool), Patiya (wood-log), and sowing implements. Around 20% have Nali, and 15% have indicated owning a bullock-card. Among all the 319 participants, five have indicated that there are Ghani in their village or adjoining village. (Figure-12)

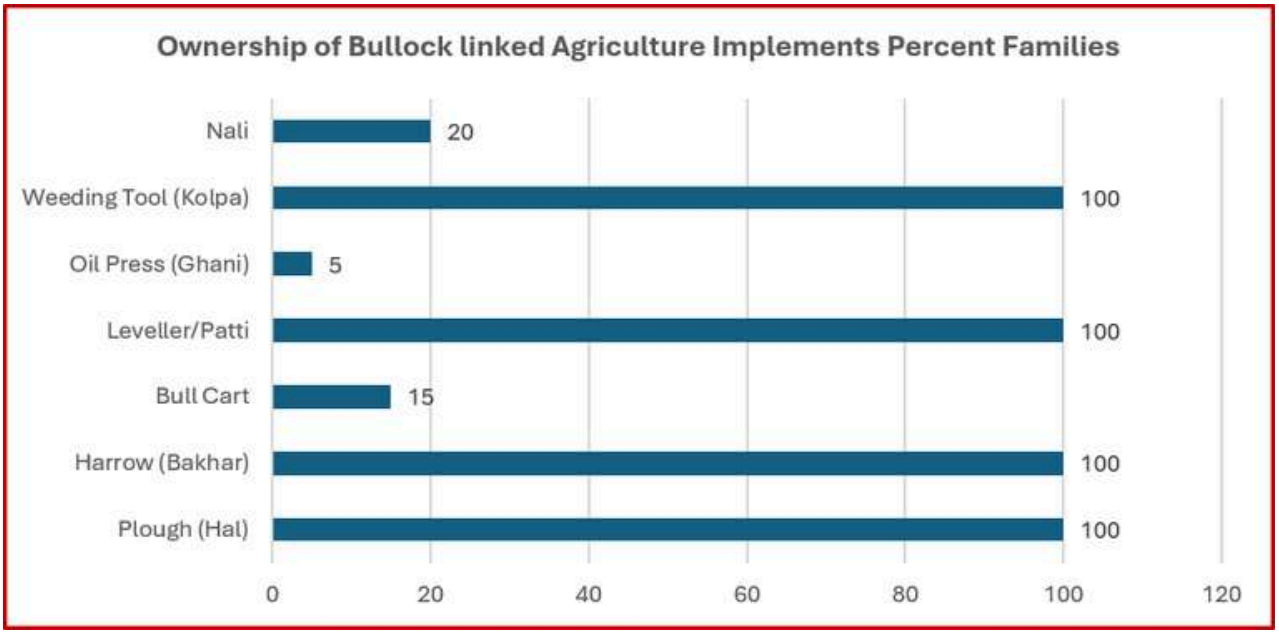


Figure 12: Percent of families' utilization of bullocks in various farming operations

5.6 Farm Benefit Factor

When asked about the benefits of bullock-based farming, all participants (319) have indicated a) freedom of farming whenever rain, b) availability of free manure for better soil fertility, c) saving on account of ploughing-related intercultural operations, d) use of crop residue as fodder, and e) cash income as benefits. 82% of participants also indicated social status as benefit.

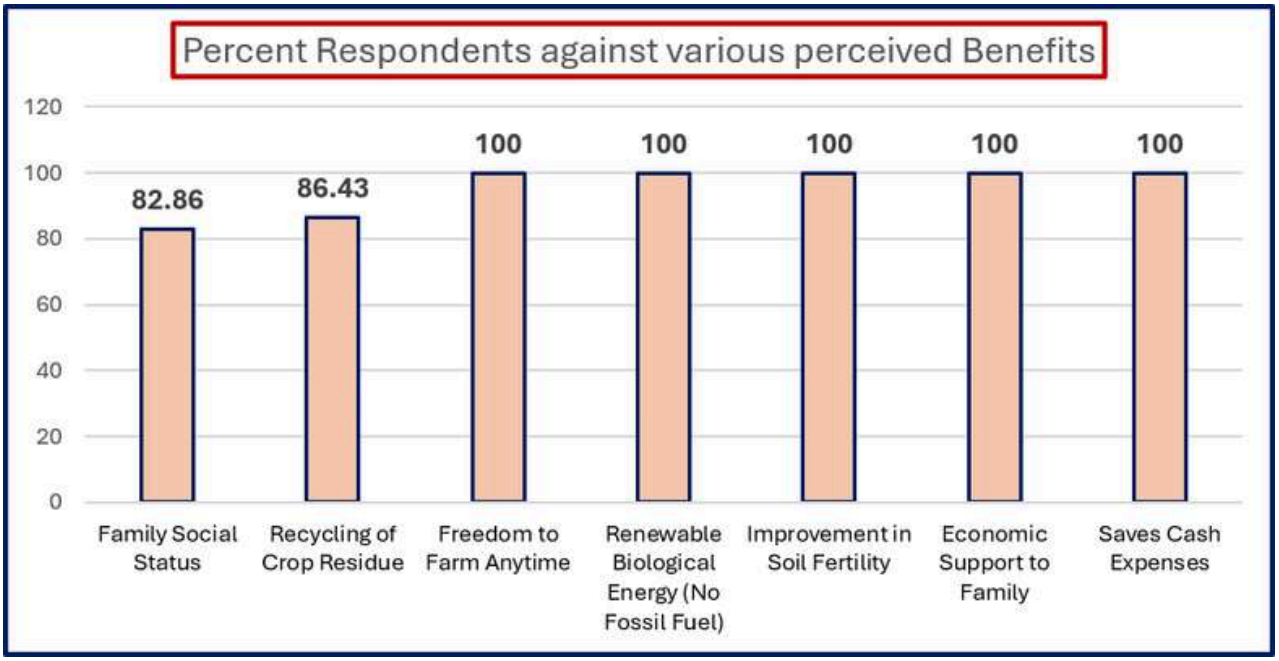


Figure 13 Perceived Benefits of bullock-based farming in the area

5.7 Key Challenges as Factor

- In response to questions regarding challenges in maintaining a pair of bullocks, the group members almost all strongly put forth high fodder cost, time consumption, and limitation of bullock carts and problems associated with taking them to market due to geographical aspects as major challenges.
- Lack of grazing land in villages is also seen as a major drawback in keeping livestock, not particularly bullock.
- Around 86% of participants indicated limited access to veterinary health services and migration of youth (working members of families) as emerging challenges.
- 65% of participants do indicate that the high cost of bullock in the market is also one of the limiting factors in the purchase of new bullock.
- Mostly bullocks in the area are either inherited from previous generations or sometimes offspring of cows in the family. During the last five years farmers hardly bought bullocks from the market. Migration of youth from rural households further affects labor availability required for livestock management, thereby influencing household decisions regarding maintenance of draught animals. (figure-14).

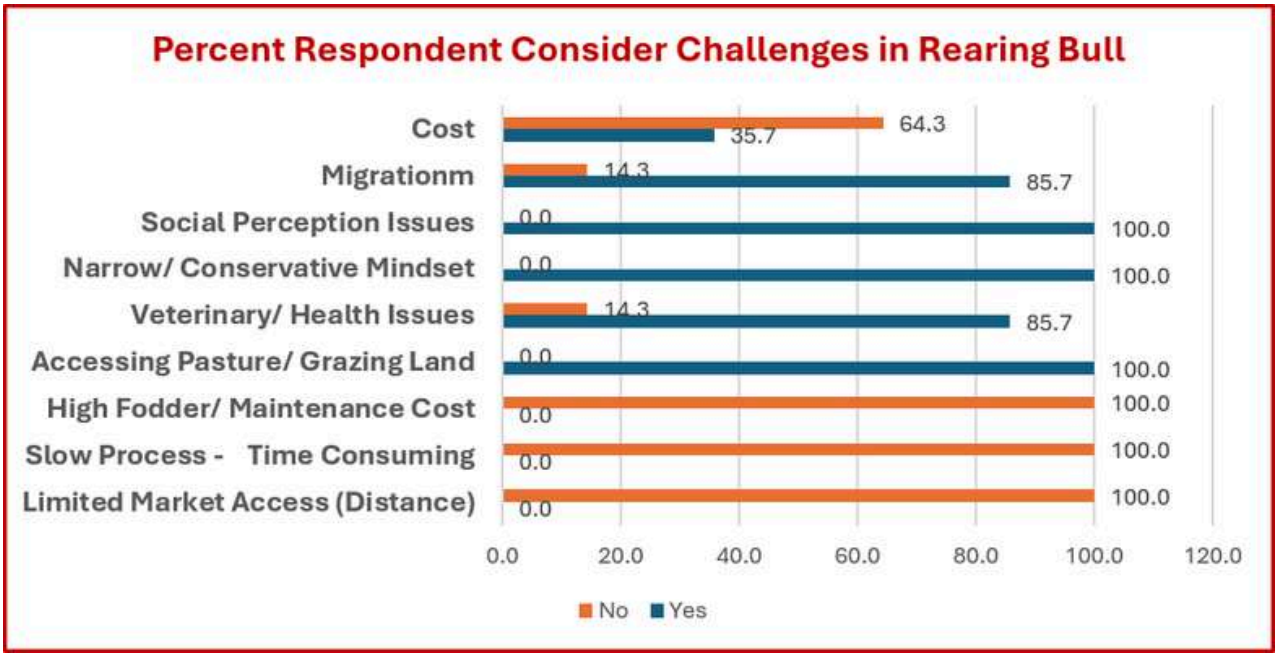


Figure 14: Percent of families and their reflections on challenges faced in maintaining a pair of bullocks

6. Discussion

The study involving 319 participants of 14 blocks in six districts of three states covered common threads around the bullock-based farming (BBF) within this undulating terrain. The details about BBF in this study share community perceptions and information captured using group interviews. The following paragraphs discuss the compatibility of BBF with modern-day concepts and aspects related to sustainable development goals such as sustainable production and consumption, circular economy, regenerative agriculture with agroecological farming, etc.

- The livestock sector accounts for 40% of the world's agriculture gross domestic product (GDP), but it is one of the sectors vulnerable to climate change. Livestock contribute both directly and indirectly to climate change through the emissions of GHGs such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Methane emissions from livestock account for about 80% of agricultural CH_4 and 35% of the total anthropogenic CH_4 emissions. Furthermore, the global livestock sector contributes about 75% of the agricultural N_2O emissions.

- Other sources of GHG emission from livestock and related activities are fossil fuels used for associated farm activities, N_2O emissions from fertilizer use, CH_4 release from the breakdown of fertilizers and from animal manure, and land-use changes for feed production. There are several techniques available to quantify CH_4 emission, and simulation models offer a scope to predict accurately the GHG emission from a livestock enterprise as a whole. Quantifying GHG emission from livestock may pave the way for understanding the role of livestock in climate change, and this will help in designing appropriate mitigation strategies to reduce livestock-related GHGs.

- Draught animal comes under the renewable energy category and provides a source of power for farm operations and manure for crop production by improving organic carbon in soil. This is an environmentally friendly source of energy for the country, as a pair of draught animals saves 247.6 liters and 881.2 liters of diesel (fossil fuel) per annum when compared to the same area being operated by a mechanical source of farm power

(tractor and power tiller), respectively. Therefore, correspondingly, they eliminate 78.636 kg and 279.9 kg of CO_2 emission per annum. Presently, dung and urine production per annum from draught animals alone is estimated to be 122.07 million tons and 132.44 million cubic meters, respectively, that may be utilized in organic farming.

- Tribal farmers use Bullocks Pair for farming, and the transport system is climate-resilient by design. During erratic weather, farmers rely on bullocks to plough or haul produce when tractors cannot operate—for instance, immediately after rains when machine use would compact wet soil or when fuel supplies are disrupted. The bullocks, being living assets, also reproduce and can be locally bred, unlike imported machinery. Overall, the study shows how bullock-based crop-livestock practices continue to deliver economic viability and climate adaptation benefits today.

- Bullocks provide manure and urine that enrich soil organic matter and fertility. Regular application of cattle dung has been shown to improve soil carbon content and microbial activity, enhancing soil health year after year. This aligns with regenerative principles of feeding the soil with organic inputs instead of synthetic fertilizers. The availability of on-farm manure closes nutrient loops, reducing external input costs for farmers.

- Tillage with bullocks and traditional ploughs causes less soil compaction than heavy tractors. Research indicates animal-drawn ploughing maintains significantly lower soil bulk density (around 0.7 g/cc) compared to tractor tillage (up to 1.2 g/cc). Lower compaction means better rainwater infiltration and root growth—critical for resilience.
- In rainfed fields, using bullocks for land preparation helps conserve soil moisture and structure, embodying low-till, regenerative farming.

- Livestock are not separate from cropping—they are part of a mixed farming system. Crop residues (like straw) feed the cattle, and cattle in turn provide draft power and manure for crops. This symbiotic design is a hallmark of sustainable indigenous farming. Such crop–livestock integration increases overall farm productivity and stability.

- Communities carry rich traditional knowledge about managing livestock in tune with nature. They select breeding stock for strength and disease resistance, use herbal remedies for cattle health, and adjust grazing patterns to seasonal fodder availability. These practices contribute to animal well-being and reduce reliance on chemical veterinary inputs, aligning with holistic approaches in regenerative agriculture. The cultural reverence for cattle (often considered part of the family and used in ceremonial functions) also means they are cared for and valued beyond their economic utility.

Optimal utilization of draught animals can reduce the farm sector's fossil fuel expenditure by Rs 60,000 crore, says a December 2018 report on increased utilization of draught animals, released by Bhopal-based Central Institute of Agriculture Engineering, under the Indian Council of Agricultural Research.

6.1 Bullocks for Sustainable Living

Bullocks Pair serve multiple functions in tribal economy and culture. They transport agricultural produce, firewood, and people; they are used on-farm for activities like bringing manure or harvest from field to home; and they even feature in religious ceremonies and community events (for example, carrying deities during festivals). This multipurpose utility reinforces the integration of livestock into daily life. The maintenance cost of a bullock cart is minimal-roughly ₹500 per year for maintenance (e.g. periodic wheel repair or yoke replacement, as wood and bamboo are locally sourced). In return, a family can earn ₹5,000 or more per year by using the cart for transport services or renting it out to others. This provides moderate supplemental income in a village with otherwise limited cash earnings. In essence, Bullocks Pair act as both a cost-saving device (replacing fuel-based transport) and an income-generating asset, illustrating a low-cost, climate-friendly rural enterprise. Bullock was the pivot of traditional cultivation due to harmony with nature, is the centre of farming today, and will remain so for future also. This is evident due to involvement of bullocks in each and every stage of agriculture and associated livelihoods.

Transportation

Ploughing

Threshing

Irrigation

Oil Expeler

Sowing

Bullock-drawn ploughs remain ubiquitous in agricultural landscapes, symbolising the enduring bond between humans and animals. Bullocks, revered as sacred animals in Indian culture as it offers following simple solutions to livelihoods. Traditional irrigation techniques such as furrow irrigation, basin irrigation, and flood irrigation have been practised for centuries in India. These methods rely on gravity flow to distribute water to fields and are well-suited to smallholder farming systems. The Khadin system is a traditional rainwater harvesting and irrigation system practised in the desert regions of Rajasthan. It involves the construction of earthen dams along the contour of sloping terrain to capture rainwater and recharge groundwater. The stored water is then used to irrigate fields through gravity-fed channels, enabling farmers to grow crops even in arid conditions.

- Provide draft power for ploughing fields, tilling soil, and transporting agricultural produce.
- Bullock-drawn ploughs are relatively simple in design and construction, require minimal maintenance, and are easy to repair.
- This traditional method of cultivation conserves fossil fuel resources and minimizes soil compaction and erosion, preserving soil health for future generations.
- Moreover, bullock-drawn ploughs are well-suited to small-scale farming operations, where mechanized equipment may be inaccessible or uneconomical.
- Bullocks enable farmers to cultivate diverse crops on marginal lands, promoting food security and livelihood resilience in rural communities.
- The bullocks provide manure for cultivation, which is a valuable organic fertilizer. The manure is then collected and spread across the fields, enriching the soil and providing nutrients to crops.
- Our farmers boast a rich history of traditional post-harvest practices. These practices play a vital role in preserving and enhancing various food items' nutritional value, flavor, and shelf life. These nature-friendly techniques don't require any sophisticated technologies and can be implemented in every part of the country. Following are some examples:
- Traditional oil extraction using bullocks in southern and eastern parts of India is a fascinating example of indigenous technology that has been practiced for centuries, particularly in rural areas where modern machinery may not be readily available or affordable. This traditional method, often referred to as 'Ghani' or 'Ghani pressing,' involves the use of a wooden or stone oil press powered by bullocks to extract oil from oilseeds such as sesame (till), groundnut (peanut), coconut, and mustard.

In many indigenous agricultural practices followed by our farmers, the thrust was always to maintain a healthy environment. Unfortunately, modern science and technology have made our precious indigenous technologies extinct and placed them under the realms of books and museums. If we want to restore our land to the level our forefathers handed over to us, we need to revive at least a few of these agricultural practices. Let us explore some common traditional practices our farmers follow.

6.2 Socio-cultural importance for communities

India has one of the oldest agricultural traditions in the world. For centuries, farmers have cultivated land using methods rooted in observation, experience, and nature. However, in the last few decades, the face of farming has changed dramatically with the introduction of technologies from labs and research stations such as chemical fertilizers, hybrid seeds, mechanized tools, and digital platforms. In indigenous area also agriculture is moving from traditional bullock-driven methods to modern, tech-enabled practices. This study shows potential of how retaining bulls and blending with modern innovations can empower today's farmers.

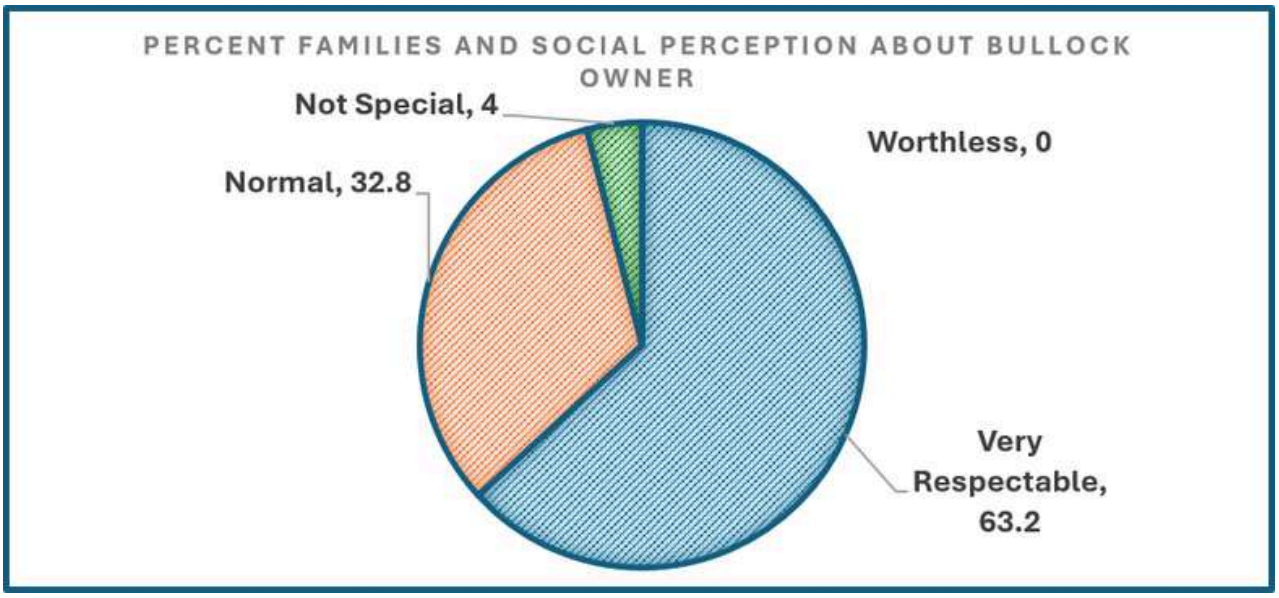


Figure 15: Percent of respondents and their perception about the bullock owner families

6.3 Revival of Bullock-based Farming-Government Initiatives

During last decade there are innovation in processes, policies, institutions and farm equipment to revive bullocks and aid small farmers. Indian Council of Agriculture Research have dedicated section and institutions to promote use of animal draught power in agriculture and other rural livelihoods.

- The University of Agricultural Sciences, Raichur, Karnataka, has developed a bullock cart-mounted electricity generation device from the movement of the cart.

- AICRP has also developed a nutritional feed, which, it claims, reduces fatigue of bullocks and enhances their energy output by almost 16 percent.

- In the Raichur district of Karnataka, the University for Agricultural Sciences, one of the nine centers of AICRP, has designed several other implements for efficient use of bullocks. "We are trying to popularize spraying of pesticides with bullocks.

7. Recommendations & Way Forward

Traditionally involving bullocks for agricultural purposes was conventional method in India's rural areas. But in recent years i.e. after independence and onset of green revolutions the approach of harnessing animal power started got ignored with increasing entry of Tractors and other equipment and implement with use of fossil fuel and electricity. This study gives some of the specific recommendation which strengthens the importance of such traditional approaches.

- Efficient harnessing of animal power; most suitable to farmers of small land holdings; relief to farmers from the increasing price of fossil fuels and electricity and environmental friendliness Success Stories.

- Use of bullocks in weeding and sowing can significantly reduce labor costs and increase efficiency. For example, many farmers have indicated saving of Rs.500 to Rs.1000 for weeding 1 hectare even as compared to manual weeding. Showing use of bullock in such a way will reinforce bullock-based farming and improve the economic resilience of small cultivators.

- ·Good-quality bullocks are missing from the area; thus, community-based breeding programs need to be promoted to improve the availability of locally adapted draught animals suited to rainfed agro-ecology and sustaining under climate variability.

- There is a wider need to organize training programs to educate farmers on the proper use of bullocks for specific tasks such as weeding and sowing.

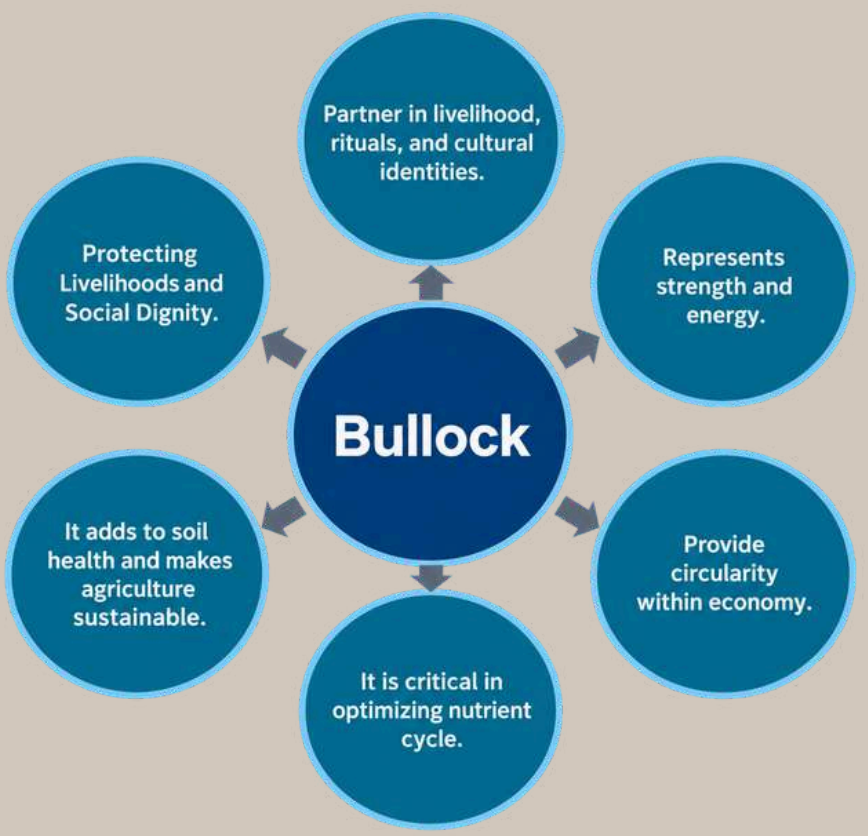
- ·These initiatives reflect the government's commitment to promoting sustainable agricultural practices and reducing reliance on modern machinery, which can have a significant impact on the agricultural sector in India.

- Community-managed bullock implement banks may improve access to animal-operated tools such as ploughs, harrows, sowing implements, and intercultural equipment for households lacking ownership of associated implements.

- Integration of bullock-based farming within village-level development planning frameworks may strengthen locally governed climate adaptation strategies through enhanced crop–livestock integration and reduced fossil-fuel dependency.

- Recently, the government has also started promoting the use of bullocks in farming. New initiatives and policies are declared on bullocks in farming.

Bullock-based farming cannot be done in isolation; it is a constituent of a sustainable agro-ecosystem where animals, crops, and people have mutually supportive roles. This model strengthens climate resilience by enhancing soil health, agrobiodiversity, and economic diversity on the farm. It offers valuable insights for us. It explores how indigenous communities integrated agriculture and livestock inherently as climate-resilient and sustainable. The tribal families have, over centuries, fine-tuned a farming system that simultaneously addresses transport, cultivation, soil fertility, and income generation—all with minimal greenhouse gas emissions and strong community ownership. As India seeks pathways to climate-resilient agriculture and regenerative rural economies, indigenous practice deserves greater recognition and support. They align well with modern-day priorities on sustainable farming and biodiversity, from promoting organic and natural farming.



The study brings out community perceptions and assessments of need of incorporating bullocks within the integration of both traditional and modern farming practices. The future lies in understanding strengths and strategically combining them for maximum benefit. With the right support, training, and awareness, Indian farmers can harness both wisdom and technology to create a more productive, sustainable, and prosperous agriculture sector. At the end the study concludes that -

It is worth having include a pair of bulls as part of farm-family and improve resilience capacity with a sustainable economy.

Annexure 1- FGD Format

बैल-अर्थव्यवस्था और पारिस्थितिकी सर्वेक्षण प्रपत्र

I. उत्तरदाता एवं स्थान विवरण

- राज्य: _____
- जिला: _____
- खंड (ब्लॉक): _____
- ग्राम पंचायत: _____
- गाँव का नाम: _____
- उत्तरदाता समूह का नाम: _____
- उत्तरदाता समूह उपस्थित सदस्य संख्या: _____. (Male...../Female...../Children.....)
- जाति (एक चुनें): अनुसूचित जाति / अनुसूचित जनजाति / अन्य पिछड़ा वर्ग / सामान्य / अन्य _____

II. भूमि विवरण

भूमि का प्रकार	**विरासत में मिली (एकड़/हेक्टेयर)**	**खरीदी गई (एकड़/हेक्टेयर)**	**किराये पर (एकड़/हेक्टेयर)**	**कुल (एकड़/हेक्टेयर)**
बीड				
ढलान				
समतल				
तालई				
परती				
आवासीय				
वाड़ी				

III. पशु पालन विवरण

पशु	**विरासत में मिले** (संख्या)	**खरीदे गए** (संख्या)	**कुल** (संख्या)	**प्रयोजन (टिक करें: जुताई/गोबर/ बिक्री/**
भैंस				
बकरी				

बैल				
भेड़				
गाय				
गधा				
घोड़ा				
ऊँट				
मुर्गा/मुर्गी				
अन्य_____ कृपया स्पष्ट रूप से उल्लेख करें				

IV. कृषि औजार विवरण

औजार	**विरासत में मिला (संख्या)**	**खरीदा गया (संख्या)**	**वर्तमान में उपयोग (हाँ/ना)**
हल			
बखर			
बैलगाड़ी			
फावड़ा			
खुरपी			
कुदाली			
दरांती (हँसिया)			
7.1.1 गेती			
अन्य _____ कृपया स्पष्ट रूप से उल्लेख करें			

V. सामाजिक दृष्टिकोण

बैल की जोड़ी रखने वाले परिवार के बारे में आपका क्या विचार है? (टिक करें)
□ बहुत सम्मानजनक
□ सामान्य
□ विशेष नहीं
□ निरर्थक

VI. बैल के चारे का अभ्यास (टिक करें)

मौसम/समय	घास (पुले)	कड़ब	खल	बन्टा	पानी	अन्य (बताएँ)
गर्मी						
सर्दी						
वर्षा						
काम के समय						
बीमारी						

VII. बैल से प्राप्त उपयोगिता/उत्पादन

मौसम	बैलमूत्र (मात्रा/	गोबर (मात्रा/	जुताई (दिन)	खेत परिवहन (दिन)	बाज़ार परिवहन	अन्य (बताएँ)
गर्मी						
सर्दी						
वर्षा						

VIII. बैल की जोड़ी रखने के लाभ (टिक करें)

□ परिवार की सामाजिक प्रतिष्ठा
□ फसल अवशेष का पुनर्चक्रण/उपयोग
□ कभी भी खेती की स्वतंत्रता
□ नवीकरणीय जैविक ऊर्जा (चारा, फसल अवशेष) से चलता है, जीवाश्म ईंधन पर नहीं
□ मिट्टी की उर्वरता में सुधार
□ परिवार को आर्थिक सहारा
□ नकद खर्च की बचत
□ अन्य (बताएँ): _____

IX. बैल की जोड़ी रखने की समस्याएँ (टिक करें)

□ बाजारीकरण की सीमितता (दूरी)
□ धीमा, अधिक समय लगता है
□ चारा/पालन का खर्च अधिक है
□ चारागाह तक पहुच की समस्या
□ पशु चिकित्सा/ स्वास्थ्य की चुनौतियाँ
□ सामाजिक दृष्टिकोण/कलंक/संकीर्ण सोच
□ अन्य (बताएँ): _____

X. आजीविका गतिविधियाँ (जहाँ बैल का उपयोग किया जाता है)

गतिविधि	**वर्ष/मौसम में आवृत्ति**	**अतिरिक्त टिप्पणी**
जुताई		
पटिया		
बुवाई		
निराई		
परिवहन		
मनोरंजन		
अन्य _____		

XI. सामाजिक/धार्मिक भूमिका

क्या बैल का उपयोग स्थानीय धार्मिक/समुदायिक कार्यक्रमों में होता है? (टिक करें)
□ हाँ
□ नहीं
यदि हाँ, विवरण दें: _____

XII. पारिस्थितिकी प्रभाव

आपके अनुसार, बैल पालने से मिट्टी, वन या जैव विविधता पर क्या असर पड़ता है?

_____
_____

XIII. आय/तुलनात्मक मूल्य

क्या आप बैल किराये पर दूसरों को देते हैं?

- हाँ
- नहीं

यदि हाँ, वार्षिक आय: _____

जुताई हेतु पसंद:
□ ट्रैक्टर
□ स्वयं के बैल
क्यों? _____

XIV. भविष्य/सतत आजीविका

आपके विचार से, परिवार/समुदाय की सतत आजीविका हेतु बैल का उपयोग कैसे बढ़ाया जा सकता है?

_____

_____

सर्वेकर्ता की टिप्पणी/अवलोकन:

_____

_____

धन्यवाद!

सर्वेकर्ता का नाम _____

मोबाइल नंबर_____

पद _____

इकाई _____

Annexure 2:- Villages selection process

Bull Study FGD Plan						
Sr. No.	**State**	**District**	**Block**	**Village**	**बाजार से कितना दूर है**	**कितने प्रतिशत परिवारों के पास बेल है**
1	Madhya pardesh	Ratlam	Bajna	Devipada	6 KM	70%
2	Madhya pardesh	Ratlam	Bajna	Chavni Jhodhiya	10 KM	70%
3	Madhya pardesh	Ratlam	Selana	Amaliya Dol Khurd	11 KM	50%
4	Madhya pardesh	Jhabuva	Petlavad	Karangarh	14 KM	40%
5	Madhya pardesh	Jhabuva	Thandla	Khandan	10 KM	70%
6	Gujrat	Dahod	Jhalod	Raypura	12Km	65%
7	Gujrat	Dahod	Fathpura	Bhitodi	09 KM (Sukhsar)	75%
8	Rajasthan	Dungarpur	Aspur	Sada	3 KM	31%
9	Rajasthan	Dungarpur	Sabla	Sundelkheda	8 KM	30%
10	Rajasthan	Pratapgarh	Pipalkhunt	Kalighati	6 KM	90%
11	Rajasthan	Banswara	Ghatol	Jambudi	7 KM	17%
12	Rajasthan	Banswara	Kushalgarh	Choti sarva	10 Km	80%
13	Rajasthan	Banswara	Sajjangarh	Kasarvadi	2 KM	70%
14	Rajasthan	Banswara	Gangadtalai	Jambudi (Lankai)	04 KM (Gangadtalai)	60-65%
15	Rajasthan	Banswara	Anandpuri	Chikli Badara	13-15 KM (Anandpuri), 7 KM (Fatahpura)	50%

आपने इस गाव का चयन क्यों किया					
जमीन का प्रकार प्रतिशत			गाव के कितने प्रतिशत परिवार पलायन जाते है	ओसत कृषि भूमि प्रति परिवार	इस गाव को चयन करने का और कोई कारण हो तो विस्तृत लिखे
70%	30%		35%	2 se 3 Bigha	पहाड़ी पर खेती करते है,पास में नदी का बहाव भी है
80%	20%		80%	4 se 5 Bigha	
80%	20%		50%	2 se 3 Bigha	
60%	30%	10%	40%	4 se 5 Bigha	ज्यादातर परिवार ट्रक्टर से खेती करते है
60%	40%		60%	3 se 4 Bigha	
25%	45%	30%	85%	4-5 Bigha	पलायन बहुत ज्यादा है, बाजार पर निर्भरता ज्यादा है,
50%	30%	20%	50%	4-5 Bigha	तीनो साइड पहाड़ी है, हम विगत 5 वर्षो से वहा पर है,पुरुषो को खेती के प्रति रुझान है
0	90%	10%	45%	4-5 Bigha	पलायन करने वाले परिवारों की संख्या ज्यादा है
75%	25%	0	30%	4-6 Bigha	लिफ्ट से सिंचाई,ढलाऊ जमीं के साथ ही जंगल के निकट का क्षेत्र है
90%	10%	0	25%	3-4 Bigha	ढलाऊ जमीन एवं गाँव के लगभग परिवारों के पास में बेल उपलब्ध है.
40%	45%	15%	010-15%	2-3 Bigha	नहरी क्षेत्र होने के साथ ही तीनो प्रकार की भूमि गाँव में है !
65%	30%	5%	70%	3	पलायन ज्यादा है,खेती पर हीर निर्भर है, नाले ज्यादा है
45%	40%	15%	55%	3	हिरमा खेती, गुजरात सीमा के पास
35%	30%	35%	30%	3-4 Bigha	तीनो प्रकार की जमीं उपलब्ध है, सिचाई की थोड़ी बहुत सुविधा है, फारेस्ट जमीं भी है,
70%	30%	0	25%	3-6 Bigha	गुजरात और राजस्थान की सीमा का गाव, बहुत उच्ची उच्ची पहाड़िया है, पानी की कम उपलब्धा, तालाब, एनिकट नही है, नहर नही है।

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