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Enhancing and Sustaining Pulse Production and Farmer Incomes in the TRFA States:

Issues of Stray Animal Grazing and Value Chain Integration for Small and Marginal Farmers

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Enhancing and Sustaining Pulse Production and Farmer Incomes in the TRFA States:

Issues of Stray Animal Grazing and Value Chain Integration for Small and Marginal Farmers

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Message

Dr. B. Rajender, IAS
Joint Secretary

सत्यमेव जयते

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Government of India
Ministry of Agriculture & Farmers Welfare
Department of Agriculture, Cooperation
& Farmers Welfare

MESSAGE

The Ministry of Agriculture & Farmers Welfare (MoAFW), Government of India, has taken several steps to address the gap between demand and production of pulses and oilseeds. Large tracts of land after rainfed paddy is taken in Kharif season are left fallow during Rabi season primarily due to absence of irrigation facilities. The Targeting Rice Fallow Areas (TRFA) sub-scheme was introduced in 2016-17 by the Ministry with the important objective of contributing to the twin goals of achieving India's nutritional security and doubling farmer's income. The TRFA is one of the key programmes focused on land that remains underutilized after harvesting of Kharif paddy crops and aims to bring a change in the cropping pattern during Rabi season by introducing appropriate varieties of pulses and oilseeds that can be cultivated using available moisture. It is being implemented through a combination of innovative technological interventions and provision of essential agri-inputs including extension services in six Eastern States – Assam, Bihar, Chhattisgarh, Jharkhand, Odisha and West Bengal that represent over 82% of India's rice fallow areas. This scheme focuses on building sustainable pulses and oilseed production in rice fallows in these regions.

The scheme was successfully implemented in 15 districts of six States during 2016-17. Buoyed by its success, the scheme was extended during 2017-18 to 40 districts and 4000 villages to cover 15.00 lakh hectare area under pulses (12.00 lakh ha) and oilseeds (3.00 lakh ha). An area of 10.72 lakh ha was achieved under pulses (9.13 lakh ha) and oilseeds (1.60 lakh ha) during the year which resulted in production of 9.04 lakh tonnes of pulses and oilseeds. It has been targeted to cover 18.65 lakh in 50 districts of six States under pulses and oilseeds with an additional production of 1.35 million tonnes during 2018-19.

Farmers face various challenges during Rabi cultivation of pulses and oilseeds. Two critical challenges are value chain integration for surplus produce and managing grazing by stray cattle/wild animals and fodder availability for livestock. The Food and Agriculture Organization (FAO) of the United Nations in collaboration with Department of Agriculture Cooperation & Farmers Welfare, MoAFW and the six State Governments has taken the important initiative to identify possible approaches to address the issues of value chain integration of small and marginal farmers into existing market and ensuring timely fodder availability. FAO conducted a comprehensive study in Chhattisgarh and Odisha states and the findings of the study has brought out important issues pertaining to open grazing by animals and value chain integration of small and marginal farmers. The report highlights the importance of multipronged approach combined with convergence of Government schemes as a key lever in meeting the objectives of the TRFA programme.

Department of Agriculture Cooperation & Farmers Welfare is thankful to FAO for conducting this timely study and is hopeful to incorporate the recommendations for effective implementation of the TRFA programme.

Rajender 9.1.2019

(Dr. B. RAJENDER)

Dated: 08th January, 2019

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Foreword

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14 January 2019

Foreword

The Food and Agriculture Organization of the United Nations (FAO) working to eradicate hunger, eliminate poverty and sustainable management and utilization of natural resources, has contributed to India's growth trajectory by supporting the Government of India and related partners in areas of rural development, agriculture and livelihoods, crops, livestock, food security, environment and agricultural sustainability and management of natural resources for the past five decades.

Improvements in agricultural productivity has come with social and environmental costs, including water scarcity, soil degradation, ecosystem stress, biodiversity loss, and high levels of greenhouse gas emissions. FAO addresses issues of food and nutrition security and end all forms of malnutrition, which is also reflected in the Sustainable Development Goal (SDG-2) of Zero Hunger. This entails transformation of food systems and promote inclusive development while sustaining our natural resource base and safeguarding biodiversity.

FAO is supporting the Government of India (GoI) to achieve its twin goals of doubling farmers' income by 2022 and achieving nutritional security. FAO's assistance includes promoting sustainable agricultural production of nutrition rich crops and Future Smart Foods such as pulses and oilseeds, development of tools that support value chain integration of small and marginal farmers into markets, and several such initiatives.

Pulses are widely grown and consumed in India owing to its high nutritional value, especially as a source of protein. While, India contributes 25% of world's pulse production, its domestic demand far exceeds available supply. This has led to frequent price volatility, and the country requiring to import pulses for domestic consumption. The Ministry of Agriculture, & Farmers Welfare (MoAFW), Government of India, has taken several steps to address the gap between demand and production of pulses and oilseeds by efficiently utilizing rice fallow in six states of eastern Indian having over 60% of India's rice fallow area.

Targeting Rice Fallow Areas (TRFA), a sub-scheme under the MOAFW, introduced in 2016-17, aims to bring a change in the cropping pattern during Rabi season by introducing appropriate varieties of pulses and oilseeds. Successful implementation of the scheme requires addressing, among other things, the challenges of provision of community animal grazing facility and that of value chain integration of surplus pulses production by small and marginal farmers.

FAO in collaboration with Department of Agriculture, Cooperation and Farmers Welfare, under MoAFW has undertaken the "*Enhancing and sustaining pulse production and improving income of farmers in the target regions: Study to address issues of stray animal grazing and value chain integration of small and marginal farmers*" study in Chhattisgarh and Odisha to address the issue of value chain integration of small and marginal farmers into market and improved fodder availability. Some of the key findings and recommendations of the study include practices and models that will help integrate farming, livestock production/ rearing and fodder management, and improve value chain integration leading to greater adoption of pulse production by farmers in the TRFA states.

FAO gratefully acknowledges MoAFW for providing this opportunity, and will continue to support the government's efforts to successfully implement the recommendations to support community based fodder management and value chain integration of small and marginal farmers to achieve food and nutritional security and increased income generation.

Tomio Shichiri
FAO Representative in India

Abbreviations

AAP	Annual Action Plans
AED	Agriculture Engineering Division
ADAPT	Analytics for Decision-Making and Agricultural Policy Transformation
APMC	Agricultural Produce Market Committee
BMGF	Bill & Melinda Gates Foundation
CF	Crude Fibre
CHC	Custom hire centre
CP	Crude protein
CPR	Common property resources
CSO	Civil society organizations
DAY-NRLM	Deendayal Antyodaya Yojana – National Rural Livelihoods Mission
DoA	Department of Agriculture
DAC&FW	Department of Agriculture Cooperation and Farmers' Welfare
e-NAM	Electronic National Agriculture Market
FAO	Food and Agriculture Organization of the United Nations
FAQ	Fair Average Quality
FAS	Farming-as-a-service
FCI	Food Corporation of India
FIG	Farmer Interest Groups
FMC	Fodder multiplication centre
FPO	Farmer Producer Organization
FSSAI	Food Standards and Safety Authority of India
FYM	Farm yard manure
GHG	Greenhouse gas
GIS	Geographic Information Systems
GoI	Government of India
GP	Gram Panchayat
HYV	High-yielding variety
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Services
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFFCO	Indian Farmers Fertilizer Cooperative Limited
IIPR	Indian Institute of Pulses Research
ITDA	Integrated Tribal Development Agency
MDM	Mid-Day Meal
MFI	Micro Finance Institutions
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoA&FW	Ministry of Agriculture & Farmers' Welfare
MSME	Micro, Small & Medium Enterprises
MSP	Minimum support price
NAAS	National Academy of Agricultural Sciences
NCDEX	National Commodity & Derivatives Exchange Limited
NDDB	National Dairy Development Board
NDP	National Demonstration Project
NFSM	National Food Security Mission
NGO	Non-governmental organization
NIAM	National Institute of Agricultural Marketing
NMHD	National Mission on Horticulture Development
NMOOP	National Mission on Oilseeds and Oil Palm
NSSO	National Sample Survey Office
NTFP	Non-timber forest products
ORMAS	Odisha Rural Development & Marketing Society
OSAM Board	Odisha State Agriculture Marketing Board
PIC	Project Implementation Committee
PDS	Public Distribution System
PACS	Primary Agricultural Cooperative Societies
RKVY	Rashtriya Krishi Vikas Yojana
RMC	Regulated Market Committee
SDGs	Sustainable Development Goals
SFAC	Small Farmers' Agribusiness Consortium
SHG	Self-help group
SNF	Solids-not-fat
SRLM	State Rural Livelihoods Mission
TRFA	Targeting Rice Fallow Areas
UN	United Nations
VCI	Value Chain Integration

Note on usage of the terms 'lakh' and 'crore':
These are terms that are widely used in Indian English and in some local languages to denote specific large numbers. A lakh is one hundred thousand (100,000). A crore is 100 lakhs or ten million (10,000,000).

Executive Summary

Pulses are an integral component of a sustainable crop-production system, as these crops are capable of biological nitrogen fixation and have low water requirements and a high capacity to withstand changing weather conditions. Pulses are widely grown and consumed in India owing to their high nutritional value, especially as a source of protein. While India contributes 25 percent of the world's pulse production, its domestic demand far exceeds the available supply. This has led to increasing pressure on prices, accessibility across different income strata, and the country importing pulses for domestic consumption.

To address these concerns, the Ministry of Agriculture and Farmers' Welfare (MoAFW), Government of India (GoI) is focused on increasing both the land area under pulse and oilseed production and the productivity of these crops. Targeting Rice Fallow Areas (TRFA) is a sub-scheme launched in six states in 2016-17 for efficient utilization rice fallow areas for the cultivation of pulses and oilseeds in rabi season. The scheme is well aligned across all the elements of the United Nations' Sustainable Development Goal (SDG) 2 on Zero Hunger; and FAO's Strategic Objectives (SOs) – (SO 1): Strengthening the enabling environment for food security and nutrition, (SO 3): Reducing Rural Poverty and (SO 4) - Enable inclusive and efficient agricultural and food systems.

Rice fallows offer the opportunity to expand crop production area and increase cropping intensity (the number of crops from a particular field in a given agricultural year). However, there are several constraints on the ability to take advantage of this opportunity. A majority of these areas remains fallow due to issues related to agronomy, farmer capacity to absorb and implement the recommended cultivation practices under TRFA, availability of quality soil, timely water supply, and so on, all of which are very important to the success of TRFA implementation. While the agronomic and technical issues described above are important for pulse and oilseed production, controlling open grazing in fields and value chain integration (VCI) of small and marginal farmers are factors that need special intervention, as these require cooperation within the community and the building of appropriate linkages with players operating in the agriculture marketing value chain.

The Food and Agriculture Organization of the United Nations (FAO), in collaboration with the Department of Agriculture, Cooperation and Farmers' Welfare (DAC&FW), under the Ministry of Agriculture & Farmers' Welfare (MoAFW), undertook the study titled "Enhancing and Sustaining Pulse Production and Farmer Incomes in the TRFA States: Issues of Stray Animal Grazing and Value Chain Integration for Small and Marginal Farmers". The field work and consultations for this study were done from March–June 2018. The aim of the study was to address the issue of VCI of small and marginal farmers into the market and to improve fodder availability.

The study was conducted in the states of Chhattisgarh and Odisha. Six TRFA implementation districts across the two states were selected for the study. The study used both qualitative and quantitative approaches to elicit information. Primary surveys using semi-structured interviews, focus group discussions, as well as participatory rural appraisal (PRA) approaches were used to draw out information about the role and activities of different value chain actors, the perceptions of fodder availability and management, and the stray cattle problem in the study areas. The primary data was supported by an extensive literature review that included research articles and published government documents and reports.

Research Findings and Recommendations

Animal grazing

The study areas are characterized by mixed farming. Agriculture and animal husbandry are inter-linked and livestock rearing forms an integral part of the rural economy. However, livestock is perceived as an asset, and not used as a source of income. Foraging needs in Chhattisgarh and Odisha are met either by the by-products of wheat, rice, and other crop residue or by less nutritious grasses, leading to low production and productivity of livestock. A majority of the animals are reared under sub-optimal conditions due to shrinkage in grazing land, poor management of wasteland, and grazing pressure. Poor livestock productivity combined with fodder scarcity and low value addition opportunities disincentivize the farmer to undertake proper livestock management.

The farmers of Chhattisgarh and Odisha effectively manage livestock through local institutional mechanisms such as charwaha (common livestock caretaker), gochar (common grazing land) and community fodder banks. Community involvement in promoting improved fodder cultivation and awareness about feeding methods are some

sustainable ways of addressing the stray cattle problem in these states, and these good practices can be replicated across other states as well. Another intervention is to use field demonstrations to increase farmers' awareness of nutritional fodder crops and enrichment of roughage.

Farmers in search of effective ways to protect rabi crops from stray cattle and wild animals spend a considerable amount of their income on physical barriers to prevent livestock and wild animals from encroaching on the crop-growing area. In Chhattisgarh, the barriers used to protect fields include artificially created fences (using materials like wood, barbed wire and rocks), natural fences like hedgerows, trees, etc., and combinations thereof. In order to promote block fencing, there is a need to identify clusters of fields suitable for rabi cultivation through Farmer Interest Groups (FIGs). Convergence of financial and technical inputs from agriculture and panchayat raj departments will be necessary to support the block fencing initiative.

Bio-fencing is another sustainable and long-term solution for protecting crops from wild animals and stray cattle. To effectively utilize field bunds, fodder trees can be promoted on the land surrounding fields, and such wood species can be planted in 4–5 m intervals. Three to four tonnes of fodder could be available annually from a bio-fence of one acre. These bio-fences will help to prevent soil erosion, protect moisture and grow fodder grasses.

For productive utilization of rice fallows, the farming system should complement the needs of the livestock sector by integrating fodder crops as an extension system for improving fodder production. Thus, dual-purpose cereal and legume crops should be promoted in upland areas where cultivation of kharif rice is practiced. The advantage of this system intensification would be increased fodder availability without compromising the main crop yield.

Value Chain Integration

The concept of value chain has its origins in the early 1980s. It involves a set of coordinated activities that are performed by one or more economic actors/operators in the provisioning of goods or services to customers. Increase in value, both real and perceived, through the set of activities is a key driver for the sustainability of the value chain. The study on VCI focused on the needs of small and marginal farmers and their relationship with other value chain actors. The TRFA programme achievements for Odisha and Chhattisgarh have been better than the outcomes for the remaining four states (Assam, Bihar, Jharkhand and West Bengal).

Given the land holding patterns (small, marginal, medium and large holdings) observed in the study regions, the volume of production is inversely related to the number of farmers in each land holding group. Medium and large farmers, while being small in number, contribute 80 percent of the total production output, while small and marginal farmers contribute only 20 percent. The problems across the value chain activities reflect the asymmetry of resource availability for small/marginal farmers and for medium/large farmers. Small and marginal producers have limited or no access to credit, aggregation and quality control services, market price information, and appropriate harvesting schedules.

Higher order value chain activities like branding and marketing of packaged produce are also not accessible to small and marginal producers. Medium and large growers have access to credit and easy availability of crop storage facilities. Given that many of them also operate as village-level aggregators of produce, they are seen to exert some level of price-maker behaviour when dealing with processors.

Both Odisha and Chhattisgarh have a well-functioning public procurement system for grains. The infrastructure has not been used for other crops where a minimum support price (MSP) is offered. The farmers in the study areas were of the view that while there is an MSP for pulses, there is little or no off-take of the TRFA pulses and oilseeds by the government. This signals weakness for the growers and they are forced to sell in open market at prices that are lower than the MSP.

The TRFA Annual Action Plans (AAPs) of the states have made budgetary provisions for crop production-related activities. However, there are no budgets available for post-harvest handling of crops. Further, the infrastructure of agri-marketing committees – Regulated Market Committee (RMC) in Odisha and Agricultural Produce Market Committee (APMC) in Chhattisgarh – and the Primary Agriculture Cooperative Society (PACS) lacks cleaning and grading equipment and staff trained in quality assessment for open market sales under the TRFA scheme.

Value chain actors like pulse and oilseed processors, transporters, dealers, etc. are critical for

movement of surplus production under TRFA to the consumers. There has been limited engagement with these actors in the planning of field activities of TRFA.

VCI is a highly complex activity that needs careful design and the participation of all stakeholders, and a single approach is unlikely to address the needs of all stakeholders. However, it is clear that building value chains for small and marginal farmers has to begin with the policy tools available with the state. The decision to deploy a particular approach is a function of several factors, some of which include budgetary allocations, convergence culture of the different line departments in the state, and cross-skilling capacities of field staff. The state will need to build appropriate feedback mechanisms to ensure that timely corrective steps are taken for long-term success.

This study proposes three routes to VCI. The first route leverages existing, operational programmes and schemes within the Ministry of Agriculture. This approach allows for better utilization of ministerial budgets in a targeted area, thereby increasing the possibility of greater impact.

The second route builds on the existing programmatic approach of the TRFA Scheme Guidelines to integrate with and go beyond the programmes of the other departments of the Ministry of Agriculture and other line ministries like the Ministry of Rural Development. It is recommended to integrate the TRFA project villages under these schemes to gain the benefits of convergence for small and marginal farmers.

The third recommended route is to modify the TRFA programme to a mission-mode programme wherein all VCI activities are within the TRFA programme. The single key ingredient of mission mode functioning is coordinated and timely action by all stakeholders supported by a commonly agreed-upon budget that is managed by the mission director. This includes activities related to production, value chain development and integration, etc.

Conclusion

The findings of the study are a starting point to address the challenges related to animal grazing and VCI for pulse and oilseed growers in TRFA states. Additional priority areas of action could strengthen the effort to improve pulse and oilseed production in these states.

Mapping of rice fallow areas based on soil moisture availability using Geographic Information Systems (GIS) and remote sensing tools would be appropriate to promote site-specific crop planning and cluster-based community farming in order to address the problem of stray cattle.

Convergence with other ongoing government schemes needs to be explored in greater detail in order to enable better design and implementation for the purpose of VCI and increasing farmer incomes.

An effective monitoring and evaluation (M&E) framework will bring out the detailed aspects of the TRFA implementation and outcomes vis-à-vis targets.

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Introduction

India is one of the largest pulse producers in the world, contributing 25 percent of the world's pulse production (Government of India, 2016). However, the share of pulses in total food grain production has declined from 16.5 percent in 1950-51 to about 7 percent in 2014-15. The land area under pulse crop production has also declined marginally, from 19.6 percent to nearly 19 percent during the same period. Inadequate adoption of production technologies, high price volatility, production risks and the lack of critical irrigation facilities have contributed to this stagnation in pulse productivity (Indian Council of Food and Agriculture, 2016). Pulses are an integral component of sustainable crop production systems, as they can fix atmospheric nitrogen, have low water requirement, and can withstand abnormal weather conditions.

India is home to about 24 percent of the undernourished people in the world (Sharma et al., 2016), a fact that underlines the importance of pulses in food and nutrition security for its growing population. The persistent and growing gap between demand and supply of pulses has, apart from putting pressure on prices, made this source of vegetarian protein inaccessible to the poor. It is therefore imperative that pulses be made affordable to the poor, who often rely on a vegetarian diet to ensure nutritional security.

Poor pulse production has resulted in an increasing deficit and depletion of foreign currency reserves through soaring import bills, unpredictable price rises and lower net profits compared to competing crops (Srivastava et al., 2010).

According to one estimate, India will require about 39 million tonnes of pulses by 2050, calling for their production to grow at an annual rate of 2.2 percent (Ahlawat et al., 2016). The growing disparity between production and consumption of pulses has resulted in more imports in recent years. To fulfil the growing demand, India has to make efforts to produce enough as well as remain competitive in order to protect domestic production. Sluggish growth in production of pulses compared to population growth has resulted in an increased demand-supply gap and, in turn, rising prices and declining per capita consumption (Narayan and Kumar, 2015). Domestic demand was higher than production during 1990-91 to 2011-12 (Figure 1), when a shortfall ranging 10 to 50 lakh tonnes was met through imports from Canada, Myanmar, Australia, USA, Tanzania and China. The per capita net availability of pulses in the country was 70.3 g/day in 1956, which had reduced to 29.1 g/day in the year 2003.

Consumers in India are regular and substantial consumers of desi (local) and kabuli chickpea, pigeon pea, lentils, mung bean, black gram, horse gram, moth beans, yellow peas, cowpea, kidney beans and other minor pulses. In 2015-16, pulse production in India was 16.47 million tonnes, which is a shortfall of 3.58 million tonnes against a total demand of 20.05 million tonnes (FAO, 2016). Pulse imports have grown at 9.8 percent per annum since 1980–81, while production increased at merely 0.47 percent per annum during the corresponding period. Total pulse imports comprised just 1.6 percent of total pulse production in India during 1980–81, but have presently risen to about 32 percent.

Figure 1
Production, demand and import of pulses in India (1990-91 to 2011-12) (Source: Narayan and Kumar, 2015)

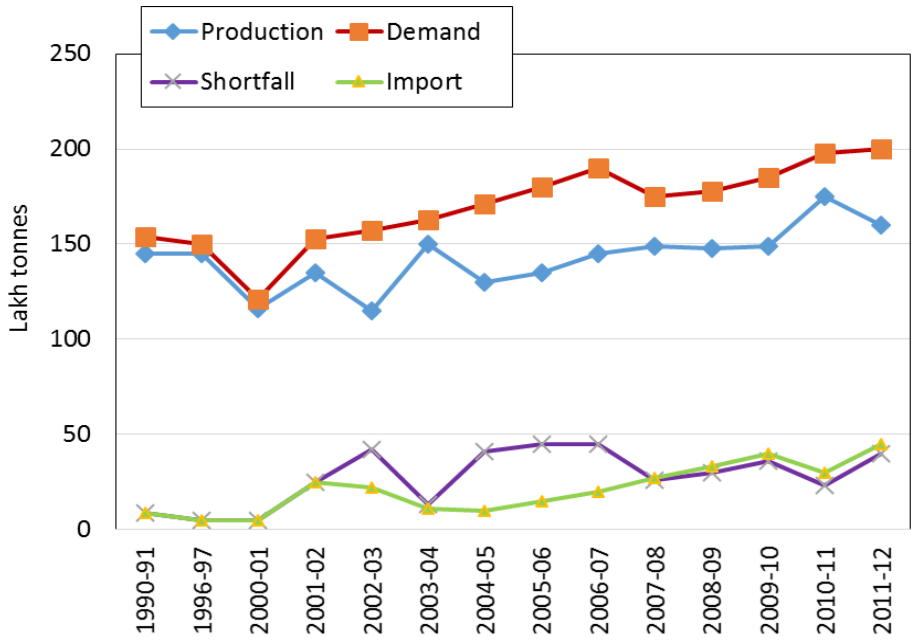


Table 1
Projected production target and demand for pulses up to the year 2022 (figures in million tonnes)

Year	Projected production target*	Increase in productivity per ha#	Projected demand**	Percent increase in demand	Gap between production and demand
2015-16^	16.35	656	22.75		-6.40
2016-17	22.95	779	23.00	1.10	-0.05
2017-18	24.00	814	23.40	1.74	+0.60
2018-19	25.00	848	23.80	1.71	+1.20
2019-20	26.00	882	24.20	1.68	+1.80
2020-21	27.00	916	24.60	1.65	+2.40
2021-22	28.00	950	25.00	1.63	+3.00
2022-23	29.00	984	25.40	1.60	+3.60

^ Base year
** NFSM target of pulse production in Expenditure Finance Committee (EFC)*
*** Based on actual consumption in 2011 NSSO family budget survey*
 # Area of 2016-17 is 29.46 million ha
Source: Government of India, 2018

Estimates by the Government of India (GoI) suggest that there is surplus pulse production compared to the projected demand for pulses in the country (Table 1). The analysis shows that in 2019-20 the projected demand for pulses will be around 24.20 million tonnes compared to a projected production of 26 million tonnes, which works out to a surplus production of 1.80 million tonnes. The surplus may go up to 3.60 million tonnes by 2022-23 with increases in production, mainly as a result of increased per-hectare productivity.

Further, the production quantity of all major pulses stood at 23.13 million tonnes during 2016-17 and it further increased to 25.23 million tonnes during 2017-18 (4th Advanced Estimates). Among the major pulses, chickpea and pigeon pea make up a major share of total pulse production, followed by black gram and green gram (Table 1a in the Annexure).

However, with the increase in production of pulses, especially over the past decade, mainly owing to yield increases supported by policies and programmes to boost domestic production, and with increased imports, the availability of pulses per capita is presently 47.2 g/day (IIPR, 2013).

Currently, pulses in India are mostly grown in semi-arid areas that face high rainfall variability, adding to high instability and low productivity. Farmers usually reserve best parcels of land with irrigation facilities for other crops. The share of different states in the area of pulse cultivation and in the production of pulses indicate that states such as Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Andhra Pradesh and Karnataka account for nearly 80 percent of the total area under pulse cultivation, contributing 80 percent of total production. Thus, a few states dominate the production patterns of individual pulse crops (Srivastava et al., 2010). The time series analysis of area, yield and production of major pulses, viz. chickpea, pigeon pea and lentil, revealed that the area under pigeon pea (from 2 to 3.8 million ha) and lentil (from 0.7 to 1.7 m ha) is increasing while the area under chickpea fluctuated between 7.8 and 8.2 m ha during the period from 1950 to 2015, indicating the implications on the overall production (Figure 2, Page 19).

In contrast, a large variety of oilseeds are produced in India, which contributes a significant share to world oilseed production. The area under oilseed cultivation in India remains between 22 to 29 million ha while production of the major oilseeds is between 20 to 33 million tonnes. In 1951, India was producing a mere 5 million tonnes of oilseed; this number went up to 9 million tonnes in 1970 and further to 25.3 million tonnes in 2015-16 (Handbook of Agriculture, GoI, 2016). One of the constraints on oilseed output has been that production is largely in rainfed areas, with only one-fourth of the oilseed production area in the country under irrigation. There is a need for enlargement of the scope of research, technology diffusion, and institutional interventions in order to enhance

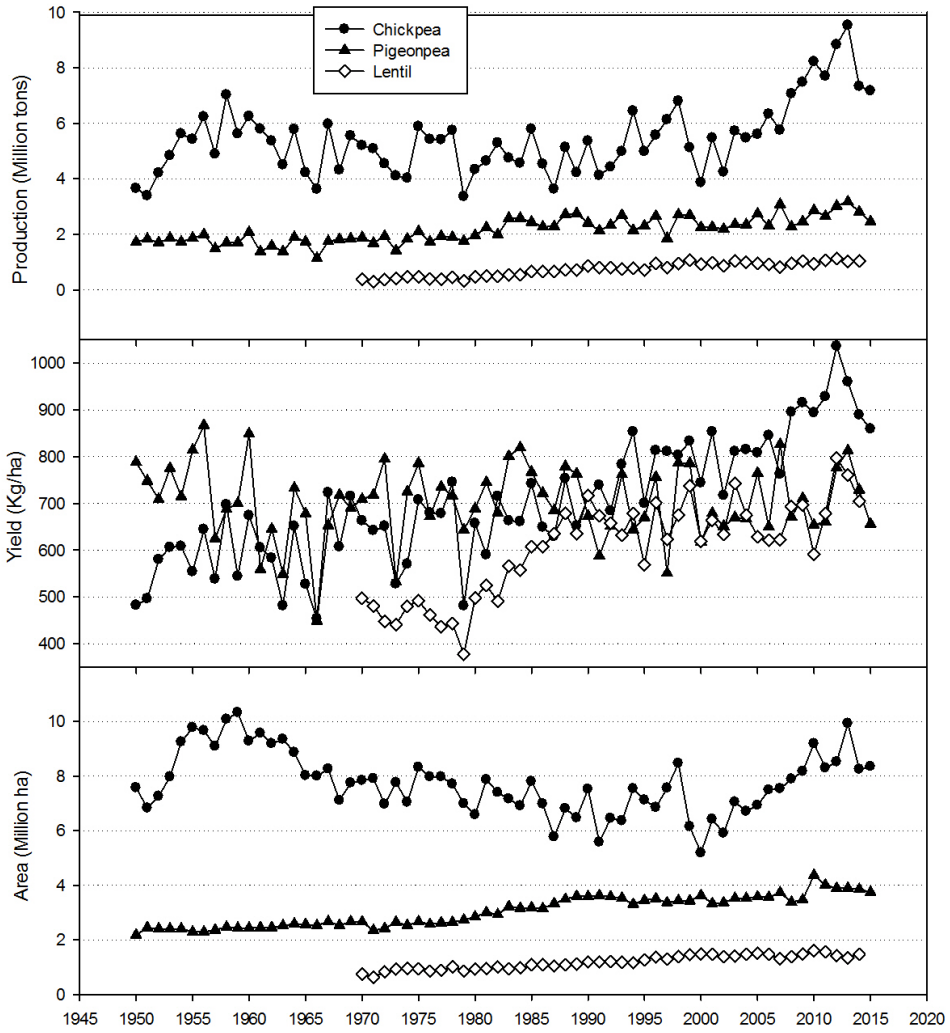
oilseed production. This would include increased public research spending on oilseed crops for the development of biotic and abiotic stress-tolerant varieties.

Lack of an assured market is one of the major issues for pulse cultivation. It is common knowledge that the prices of pulses are highly erratic. Almost all pulses are prone to seasonal price cycles, and production responds to prices with a lag, causing a recurring cycle of rise and fall in output, with prices that are affected by positive (excess production) and negative (deficient production) supply shocks. This has to do with the fact that farmers base their sowing decisions on the prices observed in the previous period, and accordingly over- or under-produce the crops, triggering a price cyclicality.

Given the volatility in prices and declining realizations from pulse crops, farm incomes remain stressed. A popular suggestion is to get the government procurement of pulses. A few other actions have also been taken by the government, such as supply of high-yielding seed varieties to ensure better yields, schemes for stabilization of pulse prices, improving producing capacity through public-private partnerships (Rallis India in Maharashtra, Tamil Nadu, etc.), and openness to external trade.

Therefore, it is imperative to develop and adopt more efficient crop production technologies along with favourable policies and market support to encourage farmers to bring more land under pulse production. In addition, making pulses affordable through domestic production, as opposed to imports, is the best way to provide nutritional security to the poor who rely on a vegetarian diet. To address the growing demand-supply gap in pulses, the Department of Agriculture and Farmer's Welfare (DAC&FW) has been vigorously pursuing pulse production programmes such as the National Food Security Mission – Pulses since 2007-08.

Figure 2
Area, yield and production of major pulses in India (1950-2015)



Further, events such as the United Nations (UN) declaration of the 2016 International Year of Pulses have acknowledged the potential of pulses to help address future global food security, nutrition and environmental sustainability. Realizing that area expansion in pulse-growing states is difficult due to the pressure from competing crops, the GoI introduced a scheme called Targeting Rice Fallow Areas (TRFA) in 2016-17 to focus on efficiently utilizing rice fallow areas for pulse production. Although rice fallows offer scope for area expansion and crop intensification, the majority of these areas (an estimated 8.5 million ha in the eastern states) remains fallow due to cultivation of long-duration rice cultivars, water-logging and excess moisture in low lands, lack of moisture in uplands at rabi crop planting time, and socio-economic problems such as stray cattle and wild animals (which deter cultivation in rice fallow areas), along with a lack of value addition opportunities at the local level.

Although both agronomic and technical issues are important, controlling open grazing in fields and value chain integrations are the most critical aspects of enhancing and sustaining pulse production and improving farmer incomes in the target region of rice fallows. Open grazing is widespread, especially in the eastern states, where a non-intensive system of cattle farming is practiced. Cattle are allowed to freely roam and graze in the village and the surrounding farming areas, and as a result, the cropped areas get damaged. Non-availability of village pastures and grazing lands acts as a deterrent to the use of fallow land for production purposes. According to the 54th round of the National Sample Survey Office (NSSO) in 1999 on common property resources (CPR), only 15 percent of the total geographical area in India was considered CPR. The survey also states that these resources have been declining at a rate of two percent per year due to encroachment and overgrazing.

Further, lack of storage facilities and procurement centres at the local level increases post-harvest losses. Due to a lack of cleaning and grading efforts, the quality of produce is also below average, leading to poor price realization. To address these critical issues, the Ministry of Agriculture & Farmers' Welfare (MoA&FW) requested the Food and Agriculture Organization of the United Nations (FAO) to undertake exploratory studies on (i) identifying feasible community-based options for fodder management; and (ii) value chain options to boost farmer income. This document reports the results of these studies.

1.1 Rice fallows as an opportunity

India accounts for 79 percent (11.65 million ha) of the total rice fallows (15 million ha) of South Asia. Of the 11.65 million ha, about 82 percent lies in eastern India and the rest falls in the three southern states of Tamil Nadu, Karnataka and Andhra Pradesh (Subba Rao et al., 2001). These areas offer scope for area expansion of pulse production and intensification. Their productive utilization can overcome many social and economic problems like unemployment, labour migration and low income (NAAS, 2013). Development and popularization of improved varieties of pulses and oilseeds suited to rice fallows of different agro-ecological regions coupled with improved agro-technologies can boost production, and thus improve income and nutritional security of the farming community (NAAS, 2013).

Moreover, introduction of legumes can provide a sustainable production base to the continued rice mono-cropped system and obviate decline in total factor productivity. Legumes contribute to reducing the emission of greenhouse gases, as they release 5–7 times less greenhouse gas (GHG) per unit area compared to other crops and allow the sequestration of carbon in soils (Stagnari et al., 2017). However, the depletion of soil moisture following the rice harvest affects timely sowing, resulting in poor returns from these ecosystems. Lack of critical/supplementary irrigation at crucial stages causes further soil moisture scarcity and hampers plant growth and crop productivity. Conservation agriculture through zero tillage, crop residue retention and crop rotation involving suitable short-duration paddy genotypes have an influence on pulse crops in rotation after rice. Two cropping systems, viz. relay cropping of pulses in standing rice and crop rotation after harvest of rice, have the potential for popularization and adoption depending on the agro-ecosystem involved. Yet, these constrained areas require an understanding of ecology, constraints analysis and situation-specific remedies.

Various studies have suggested some potential management steps involving suitable pulses varieties, zero tillage, relay cropping, residue retention, mulching, seed priming, critical irrigation and foliar sprays of nutrients, which could help improve pulse productivity under rice fallow conditions (NAAS, 2013).

1.2 UN Zero Hunger Goal and Targeted Rice Fallow Areas (TRFA)

The TRFA scheme, funded under the National Food Security Mission (NFSM), is well aligned across all the elements of the UN's Zero Hunger Goal. The Zero Hunger vision reflects five elements from within the Sustainable Development Goals (SDGs), which, taken together, can end hunger, eliminate all forms of malnutrition, and build inclusive and sustainable food systems (UN, 2015). About 82 percent of rice fallow areas are in the eastern states of India, viz. Assam, Bihar, Chhattisgarh, Odisha, West Bengal and Jharkhand, which are the focus states for the TRFA scheme. These states have little or no opportunity for agricultural income in rabi due to the absence of several factors – irrigation facilities, access to production and marketing technologies appropriate for rabi pulses and oilseed cropping cycles, and finance for sustaining production in the face of climate-related risks.

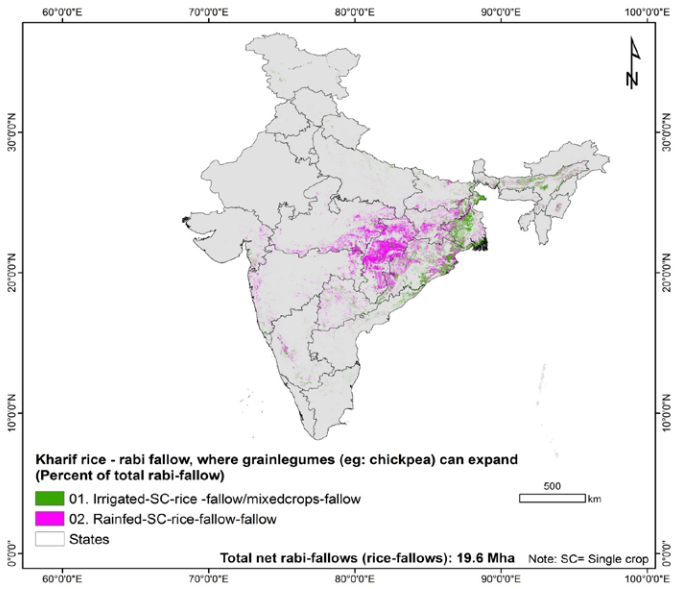
The GoI's initiative on building sustainable pulse production in rice fallows in these regions will have a positive impact on overall income and nutritional outcomes in the region. The surplus production generated by this initiative will also positively impact the rest of the country. The comparative table below illustrates the match of the TRFA scheme with the five key elements of the Zero Hunger Challenge.

The TRFA scheme of the Department of Agriculture Cooperation and Farmers' Welfare (DAC&FW) of the GoI has the very important objective of contributing to the twin goals of India's nutritional security and doubling farmers' incomes, while also positively contributing to the global goals of the UN's Zero Hunger Challenge.

TRFA & UN'S Zero Hunger Goal

Zero Hunger Goal	TRFA Scheme
Sustainable Food Systems	✓✓
Doubling Producer Income	✓✓
Access to healthy diets	✓✓
End to Malnutrition	✓✓
Eliminate Food Loss or Waste	✓✓

Figure 3
Rice fallows in India (Source: Gumma et.al., 2016)



State	Rainfed: rice-fallows	% of total rice-fallow
Chhattisgarh	4111731	35.2%
Madhya Pradesh	1871816	16.0%
Orissa	1793852	15.3%
Jharkhand	975780	8.3%
Maharashtra	664907	5.7%
West Bengal	605092	5.2%
Telangana	407943	3.5%
Assam	302036	2.6%
Bihar	266314	2.3%
Karnataka	235265	2.0%
Gujarat	168620	1.4%
Andhra Pradesh	95469	0.8%
	11,498,823	98%

1.3 Performance of the TRFA scheme

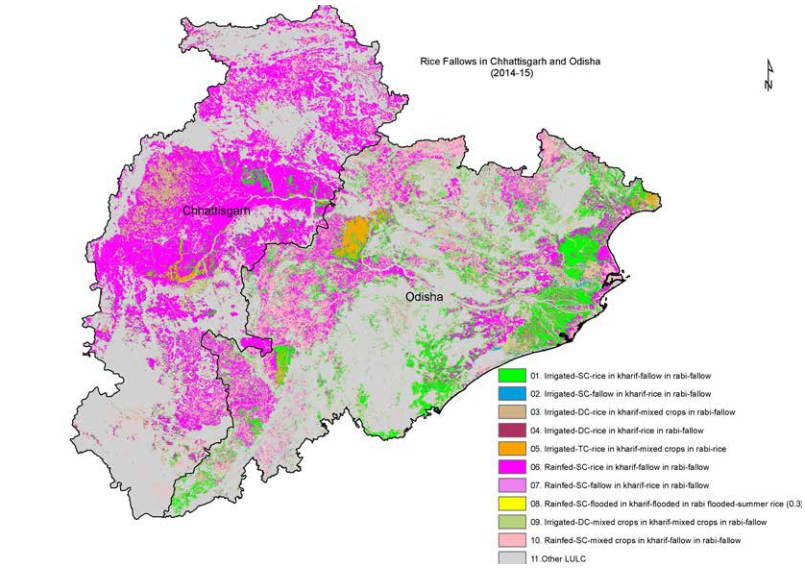
The performance of the TRFA scheme during rabi 2017-18 is reviewed in the succeeding paragraphs with the objective of understanding overall achievements against plans and also with respect to the objectives of the TRFA guidelines.

One of the salient features of the TRFA scheme's design is its focus on integrated production-related activities and post-harvest handling of crops. This is very much in alignment with the overall guidelines of the NFSM and the National Mission on Oilseeds and Oil palm (NMOOP) of the DAC&FW. Both these programmes have provisions for budgeting for value chain integration activities, such as mini dal mills, oil expellers, etc. The Operational Guidelines of the TRFA Scheme (https://rkvy.nic.in/static/download/pdf/Rice_Fellow_Guideline.pdf) state that its objective is 'to create need-based irrigation, mechanization, post-harvest and marketing infrastructure in the project areas for sustainable cultivation of oilseeds and pulses' (Objective 3.4).

The planning and budgetary provisioning for VCI activities is an essential element of demonstrating the sustainability of the TRFA programme. Farmers, especially small and marginal farmers with limited or no access to post-harvest linkages, don't have the necessary resources to process and sell their crops to customers. They are predominantly dependent on local village traders to dispose of the surplus. In this context, provision of infrastructure at the village level or Gram Panchayat (GP) level for pulse processing and oil expeller pressing will be a strong incentive for small and marginal farmers to take up rabi production of pulses and oilseeds. The programmatic budgets for TRFA need to be planned and funds released to ensure that this infrastructure is in place ahead of the rabi harvest season. However, a quick review of the approved Annual Action Plans (AAP) for TRFA rabi 2017-18 (https://nmoop.gov.in/Circulars/2017-18/Cir_AllocationFunds_TRFA_Aug2017.pdf) indicate that no plan has been made and neither is there a budgetary provision for Value Chain Integration (VCI)-related infrastructure in pulses and oilseeds.

During 2017-18, the scheme was extended to 40 districts and 4000 villages, with a target to cover 15.00 lakh ha, of which pulses would be 12.00 lakh ha and oilseeds coverage would be 3.0 lakh ha, through cluster demonstrations, mini kit distribution, and training to the farmers. The actual achievement for the 2017-18 season stood at 10.72 lakh ha (71 percent of plan), of which the area under pulses was 9.13 lakh ha (76 percent of plan) and the area under oilseeds was 1.6 lakh ha (53 percent of plan) in rice fallows, covering 43 districts and 3739 villages (minutes of the TRFA Review Meeting held on 8 June 2018). The additional area coverage resulted in production of 9.04 lakh tonnes of pulses and oilseeds, as against the production target of 10.00 lakh tonnes (Annexure 1). Most rice fallows were covered under the following pulses: pea, lentil, black gram, green gram, chickpea, pigeon pea and lathyrus (Figure 4). The oilseeds grown in rice fallows were mustard, sesame, sunflower, groundnut and linseed.

Figure 4
Rice fallow areas in Chhattisgarh and Odisha (source: Gumma et. al., 2016)



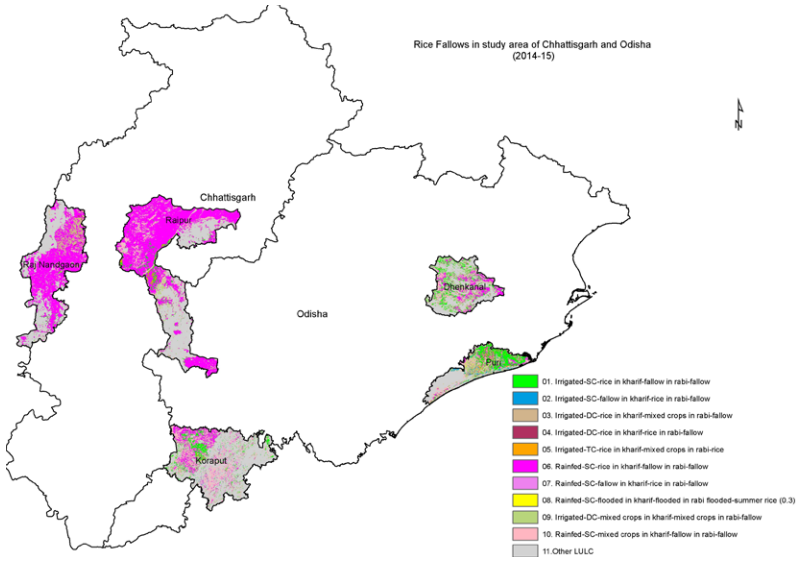


Table 2
TRFA rabi 2017-18 Performance Summary for 6 States

	GoI release (INR Cr)	Budget utilized (%)	Plan area coverage (million ha)	Area achieved (%)	Output plan (tonnes)	Output Achievement (tonnes)
Overall	98.27	66	1.2	76	10,00,000	9,00,000

An overall summary of the performance of the TRFA scheme during rabi 2017-18 is given in Table 2. The table aggregates the targets for the six TRFA states (Assam, Chhattisgarh, Jharkhand, Bihar, Odisha and West Bengal) along with the budgetary allocation (GoI component at 60 percent for all states other than Assam, where it was 90 percent).

Table 2 highlights the achievement of output (area and production) for rabi 2017-18 along with budget utilization. While the output achievement is impressive at 90 percent of the target, other parameters like area coverage in each state are well below target. Further, fine-tuned data is needed to gain a better understanding of the linkages of financial outflows of 66 percent of planned GoI contribution resulting in 76 percent of target area coverage and 90 percent achievement of the production target. A detailed analysis of the actual implementation supported by a review of expenditures and outcomes will allow policy-makers to design improved interventions and will contribute to better budgeting in future years. An intensive monitoring and evaluation study is required to bring out programme elements that have performed well and those that need modification in the next round of implementation.

1.3.1 TRFA performance during rabi 2017-18 in Odisha

Odisha state has been implementing the TRFA scheme since 2016-17. During 2017-18, nine districts, namely Puri, Sundergarh, Koraput, Sambalpur, Dhenkanal, Mayurbhanj, Balasore, Bhadrakh and Kalahandi, covering 854 villages were under it. The total rice fallow area of the state is about 29.61 lakh ha and the projected area for the nine districts was 12.21 lakh ha. As per the state's performance report, an area of 2.18 lakh ha was covered under TRFA (pulses 2.04 and oilseeds 0.14 lakh ha) during 2017-18, as against a target of 4.30 lakh ha. An additional production of 1.40 lakh tonnes of pulses (average yield 658 kg/ha) and 0.08 lakh tonnes of oilseeds (average yield 1700 kg/ha) were achieved under TRFA.

Out of the total allocation of INR 21.98 crores under TRFA-pulses, the state utilized the entire amount of INR 21.98 crores. In case of TRFA-oilseeds, the state utilized INR 2.71 crores as against an allocation of INR 3.09 crores. As per the state government's quick assessment, these are the challenges faced during TRFA implementation during rabi 2017-18:

- Poor crop standing
- Delayed sowing
- Poor germination
- Poor physical condition
- Lack of improved pulse varieties to withstand yellow mosaic virus (YMV) and powdery

mildew – addressed by introduction of IPM 2-3 & IPM 2-14 to a considerable extent
- Delayed sowing under deficit soil moisture due to long-duration rice
- Poor or no nutrient management
- Lack of scope for mechanization

1.3.2 TRFA performance during rabi 2017-18 in Chhattisgarh

Chhattisgarh has been implementing TRFA since 2016-17. During 2017-18, five districts, namely Raipur, Raigarh, Rajnandgoan, Kanker and Kondagoan, covering 427 villages were under it. The total rice fallow area in the state is estimated at 28.56 lakh ha and the area in the five districts is 18.59 lakh ha. As per the state's report, 4.98 lakh ha was covered under TRFA (pulses 4.48 ha and oilseeds 0.49 lakh ha) during 2017-18, as against the target of 3.50 lakh ha. An additional production of 2.12 lakh tonnes of pulses (average yield 750 kg/ha) and 0.29 lakh tonnes of oilseeds (average yield 697 kg/ha) was achieved under TRFA.

Chickpea, lentil, green gram, black gram and pea are the major pulses, and mustard, linseed, sesame, groundnut are the major oilseed crops grown in rice fallows.

Out of the total allocation of INR 12.23 crores under TRFA-pulses, the state spent INR 10.18 crores. In the case of TRFA-oilseeds, the state utilized INR 2.17 crores as against an allocation of INR 3.05 crores. The state also noted the following difficulties in the implementation of TRFA:

- Obstructed expansion of double crop area due to the trend of open grazing
- Lack of firm marketing system
- Lack of processing industry for crops other than paddy
- Lack of water conservation structures
- Dependency on other states for seeds of pulses and oilseeds
- Inadequate arrangements for procurement of pulse and oilseed crops at minimum support price (MSP)


राष्ट्रीय कृषि बाजार
ई बिडिंग हाल
कृषि उपज मण्डी समिति, भाटापारा, जिला-बलौदा बाजार भाटापारा(छ.ग.)
NATIONAL AGRICULTURE MAKET
E Bidding Hall
Agriculture Produce Market Committee, Bhatapara, Dist. Balodabazar (C.G.)

Enhancing and sustaining pulse production and farmer incomes in the TRFA states

2.1 Objectives, approach and methodology

The primary objectives of the study were to a) identify feasible community-based fodder management options and innovative methods to control stray cattle and b) identify suitable approaches that could lead to the enhancing of VCI around pulses, especially for small and marginal farmers. Seeking implementable solutions to the twin problems of animal grazing and post-harvest VCI has the potential to incentivise producers to take up production of pulses in rice fallow areas.

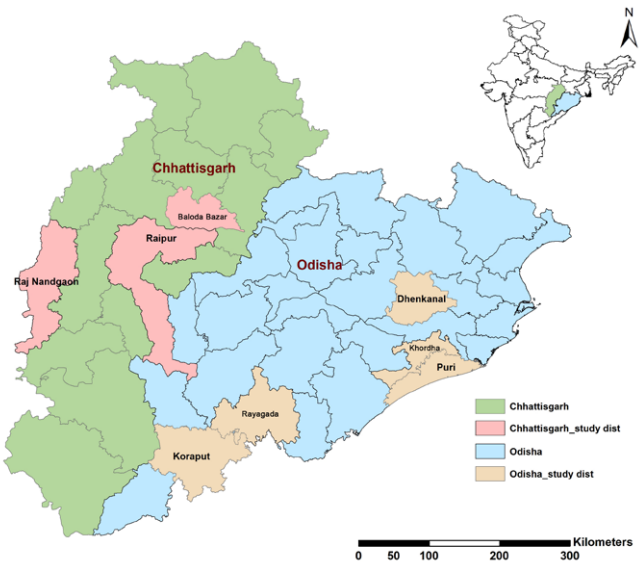
The selection of the study area was a deliberate exercise. While the six TRFA states have large tracts of rice fallow land, the agro-ecological profiles and the rabi cultivation practices in each state are very different. Based on an assessment by officials at the DAC&FW, three criteria were set: the study area would be in states with high dependence on paddy in kharif, high potential for large-scale pulse cultivation in rabi, and existing momentum for the TRFA scheme implementation. This led to the choice of Chhattisgarh and Odisha to conduct the exploratory study.

A two-tier governance mechanism was established that would ensure streamlined functioning of the study. A statewide Project Implementation Committee (PIC) under the chairmanship of the Joint Secretary (Crops), DAC&FW, GoI, was created to provide overall direction and guidance. The committee consisted of members representing both production and agriculture marketing departments, thereby ensuring a holistic view of the needs of the TRFA scheme. Members of the PIC include the Director, Agriculture (Odisha and Chhattisgarh); Director, Agriculture Marketing Board Odisha; Managing Director, Mandi Board Chhattisgarh; and FAO representative. A state-wise supporting committee was set up to select districts for the field study, support data collection, and for overall coordination. Its members are the Nodal Officer NFSM Odisha & Chhattisgarh; officers of Agriculture Marketing, Food Processing/Industries/Agri Business/ MSME; Directorate of Rice Development (Patna); Directorate of Pulses Development (Bhopal) for Chhattisgarh; and FAO representative.

Selecting the district involved wide consultation within the PIC and views were also sought from the Directorate of Pulses, from national consultants of DAC&FW, and FAO. As previously stated, Odisha state was implementing TRFA in nine districts and Chhattisgarh in five districts. The first meeting of the PIC was convened on 8 March 2018 at DAC&FW, along with representatives of the Chhattisgarh state government and FAO. The objectives of the meeting were: a) to identify the districts, b) seek guidance from the PIC on the approach and methodology of the study on animal grazing and VCI, and c) agree on the overall field study plan, including the proposed stakeholder consultations. Given that the end of the rabi season was near, and given the constraints on time, location accessibility, etc., it was decided to have a sharper geographical focus and limit the number of districts to be covered for the two study components:

- Animal Grazing – field work to be done in one district each in Odisha and Chhattisgarh
- Value Chain Integration – field work to be done in two districts each in Odisha and Chhattisgarh

Figure 5
Study districts in Chhattisgarh and Odisha states



The TRFA teams from the two states identified specific districts within each state based on criteria of overall representativeness, availability of stakeholders, and on-ground TRFA activities during field visit days. Rajnandgaon district in Chhattisgarh and Dhenkanal district in Odisha were identified to study community-based fodder management options and innovative methods to control stray cattle in targeted rice fallow areas. However, a few other districts (Puri and Koraput in Odisha and Raipur in Chhattisgarh) were also covered, partly to understand the problem of stray cattle and wild animals. For assessing the VCI, Raipur and Rajnandgaon in Chhattisgarh and Puri and Koraput districts in Odisha (Figure 5) were identified.

Based on an initial survey and consultations with state government officials, it was agreed that districts where value chain activity was already taking place should also be surveyed, even though the districts were not under TRFA coverage during rabi 2017-18. Hence, an additional three districts were added to the field work to ensure coverage of locations where most of the post-harvest activity takes place. In Chhattisgarh, Balod Bazaar district was added, and in Odisha, Rayagada and Khorda districts were added to the field work.

2.2 Methodology for studying open grazing

The problem of open grazing in rice fallow areas involved socio-economic and environmental factors such as limited financial resources of the farmer, seasonal migration of the male member of the household in search of jobs, degradation of traditional grazing lands, unpredictable water availability, poor soil health, and also sub-optimal performance of existing institutions. This called for the formation of a multi-disciplinary team of scientists, including an economist (natural resource management), an agronomist (system agronomy), and an animal scientist (fodder/foraging expert). Based on the PIC's recommendations, field visits were undertaken in March and May-June 2018 to one district each in Chhattisgarh and Odisha to understand open grazing.

To have a better understanding of issues and constraints in community fodder management, the team consulted a large number of stakeholders in both Chhattisgarh and Odisha, including farmers, line department officers (e.g., Department of Agriculture, Department of Animal Husbandry, Department of Forest, etc.), non-governmental organizations (NGOs), self-help groups (SHGs), dairy farms, and community groups, namely Farmer Producer Organizations (FPOs). During the visit, the study team also visited TRFA demonstration fields, interacted with farmers and farmer groups, and obtained information regarding the stray cattle menace and other technological and agronomic management problems in establishing the crop during the rabi season.

One district in each state was identified in consultation with the Department of Agriculture (DoA), the Department of Animal Husbandry, and district-level nodal officers of TRFA. The criteria for selecting a district were the presence of rice fallow areas and the manifestation of open grazing in rice fallow areas. The consultations were supported by an extensive literature review of research articles, published government documents, reports, etc. A number of focus group discussions were held with the community and key informants in each of the selected villages (Figure 6), to give us insights into open grazing in rice fallow areas and the extent of the stray cattle problem.

Although the constraints in rice fallow areas are manifold, controlling open grazing is the most critical challenge for enhancing as well as sustaining pulse production and thereby improving farmer incomes in the target region of rice fallows. Hence, the focus was on understanding the depth

Table 3
Stakeholder consulted and villages covered in Chhattisgarh and Odisha

Respondents	Chhattisgarh	Odisha	Total
Department of Agriculture	16	15	31
Department of Animal Husbandry	4	3	7
No. of Villages covered	8	7	15
No. of FGDs conducted	8	7	15
No. of farmers	162	147	309

of the problem and seeking suggestions from different stakeholders to boost pulse production in the country, particularly in rice fallow ecologies. To identify feasible community-based fodder options, key officials of line departments of the Department of Agriculture and Animal Husbandry and farmers were consulted. Details of the stakeholders consulted are in Table 3 & Annexure 2.

Figure 6
Interaction with farmers and line department officers in Puri and Dhenkanal districts, Odisha

2.3 Studying value chain integration

The study on value chain integration requires an end-to-end understanding of the challenges in trying to integrate small-holder producers into the market-oriented agriculture system. The challenges assume greater proportions in the context of surplus production through marginal lands and with limited resources. The opportunity landscape needs to be carefully understood in order to recommend solutions that could have a long-term impact on the income of the producers and other value chain actors while minimizing risk exposure to the producer. The value chain approach also provides a framework within which opportunities for leveraging agriculture for nutrition can be identified, assessed and implemented (Hawkes and Ruel, 2012). The study of VCI was conducted by FAO Agri Value Chain Specialist Raman Ahuja, who undertook field visits and also engaged with different officials at the state and district levels. The fieldwork was done in seven districts in the two states in the months of March and May-June 2018. The scheduling and selection of the districts was done in consultation with the departments of agriculture and agriculture marketing of the respective states under the overall guidance of DAC&FW.

A primary survey, using a semi-structured interview format, was conducted with over 200 value chain actors. The key focus of these interviews was on the roles and activities of different value actors and the linkages among them. Table 4 provides details of the stakeholders consulted for the study on VCI in Odisha and Chhattisgarh. The value chain actors interviewed include growers, traders, mandi officials, processors, aggregators, warehousing companies, and civil society organizations (CSOs) involved in promoting small farmer value chain integration. Consultations were also held in the state capitals with research organizations, financial services companies (banks, microfinance institutions, etc.), research institutions, etc. (Annexure 3 provides the details of these meetings along with individual names and organizations).

Officials from the Small Farmers' Agribusiness Consortium (SFAC), the National Commodity and Derivatives Exchange (NCDEX), etc. were interviewed to understand how farmers and farmer groups are integrating with available market and financial institutions. Entrepreneurs, technology providers and innovators were interviewed in both states to add to the understanding of the challenges and emerging opportunities in VCI. After each field visit, a feedback session was held with one of the members of the PIC at the state. Similar feedback consultations were also held with members of the

Table 4
List of stakeholders consulted in Chhattisgarh and Odisha

Stakeholder	Chhattisgarh	Odisha	Total
Farmers	30	42	72
Traders (village level aggregators)	8	14	22
Mandi agents	7	10	17
E-NAM markets	2	2	4
Processors	10	15	25
Government functionaries	15	20	35
Banks, MFIs	3	5	8
Civil Society Organizations	5	8	13
Agri Input providers	3	2	5
Research & Consulting Organizations	2	4	6
Collateral managers	1	1	2
Startup Entrepreneurs	3	5	8
Total	89	128	217

PIC at the DAC&FW. This ensured that the study was progressing as per the overall guidelines and that operational issues were addressed in a timely manner.

The consultations were supported by an extensive review of documents of the DAC&FW. These included the guidelines of TRFA, NFSM, NMOOP, the Handbook of the Department of Agriculture, etc. Where available, the state AAP and budgets for TRFA and NFSM were reviewed to understand budgetary provisions for value chain-related equipment in the AAP. A review of FAO literature was done to ensure that knowledge on the Zero Hunger Challenge programme was captured and that other appropriate frameworks (if any) were deployed as part of the study. The available literature on value chains in rice fallow areas was also reviewed to gain an appreciation of the existing body of knowledge that could be applied to devise approaches for VCI for pulses grown under rice fallow conditions.

2.4 Limitations of the study

A systematic study addressing the challenges of stray animal grazing and VCI to support sustainable production in rice fallows involves considerable time and resources to apply new tools and approaches. The authors have attempted to cover extensive ground while working with several challenges and limitations. The major challenges in the study were the lack of data and the difficulty of scheduling field consultations after the ending of the rabi season. Field implementation details, outcomes achieved, and productivity of interventions are some examples of data gaps. In addition, real-time engagement with farmers during the cultivation season brings out more recent information and is likely to offer a more up-close view of issues and opportunities.

Further, the exploratory nature of the study restricted the area coverage and also the number of stakeholders interviewed. Thus, the study team necessarily depended on qualitative approaches, such as focus group discussions with the community and key informants, and formal and informal interactions with different stakeholders to gather information on the study objectives. The information gathered through qualitative approaches was substantiated by an extensive literature review to complete the study. In addition, there is limited scope for generalization and replicability of the study findings in other areas, as these findings are based on area-specific observations and stakeholders' perceptions.

Study findings – Identifying feasible community-based options for fodder management

The intertwined nature of agriculture and livestock is a source of security and stability for poor and marginalized households, especially in arid and semi-arid regions. The livestock sector in India is dependent on crop residues for feed, while arable land is used for agriculture. However, agriculture has been witnessing a rapid increase in the use of mechanical power, and a transformation from subsistence to market-oriented farming; these changes have impacts on animal husbandry practices. In India, fodder is not produced in rural areas and animals generally consume naturally grown grasses and shrubs which are of low quality in terms of protein and available energy.

Common pool resources play an important role in fulfilling more than 70 percent of the fodder requirements in arid and sub-humid tropics, whereas in semi-arid regions, crop residues meet more than 60 percent of the fodder requirements. In general, livestock-rearing in rural areas is dependent on different institutional mechanisms such as charwaha (shepherds), community fodder banks, etc. The Planning Commission's Working Group on Animal Husbandry and Dairying (2002-2007) has estimated that fodder availability in the country falls well below what is required. The green and dry fodder deficit has been gradually increasing and is estimated to reach 759 million tonnes and 162 million tonnes respectively by 2025 (Table 5). In view of the large number of resource-poor households dependent on open grazing for their livestock, the Planning Commission suggested revitalizing the degrading common fodder and pasture resources and improving their productivity (GoI, 2011).

In view of the deficit in fodder availability combined with the increasing number of low-yielding nondescript animals, farmers have no incentive to manage livestock effectively. Shrinkage or total loss of common grazing lands due to encroachment has further affected livestock management in most areas. Therefore, farmers often abandon their livestock in unrestricted open grazing land, causing crop damage. According to Anusandhan Sansthan (2017), a cow research institute in Mathura, Uttar Pradesh, the economic cost of rearing an unproductive cow is US$ 0.86/day. Rearing 5.3 million stray cattle can cost the country US$ 1658 million (www.downtoearth.org.in/news/economy/how-expensive-is-it-to-maintain-unproductive-cattle--57410).

Anusandhan Sansthan estimated that there are approximately 2 million stray cattle in the eastern states of India, with Odisha itself accounting for 22 percent (1.14 million) of the country's total stray cattle. Meeting the fodder requirements of both milch and stray cattle calls for effective land and fodder management options, especially through the use of barren and fallow lands (permanent and rice fallows) with the help of the farming community. According to one estimate, production from rice fallows could contribute 30 percent of crop residue towards cattle feed, which is crucial for feeding livestock (Singh, et al., 2016).

The findings of this study on the challenges of animal grazing have been divided into nine subsections, which follow. Subsections 3.1 to 3.6 outline major constraints, opportunities and suggestions received from different stakeholders for addressing fodder scarcity and the problem of stray cattle. Subsection 3.7 summarizes the community efforts to address the problem of stray cattle in Chhattisgarh and Odisha. Poor agronomic practices and convergence efforts are highlighted in subsections 3.8 and 3.9.

Table 5
Demand and supply scenario of fodder resources in India (in million tonnes)

Year	Supply		Demand		Deficit		Deficit	
	Green	Dry	Green	Dry	Green	Dry	Green	Dry
2000	384.5	428	988	549	604	121	61.10	21.93
2005	389.9	443	1,025	569	635	126	61.96	22.08
2010	395.2	451	1,061	589	666	138	62.76	23.46
2015	400.6	466	1,097	609	696	143	63.50	23.56
2020	405.9	473	1,134	630	728	157	64.21	24.81
2025	411.3	488	1,170	650	759	162	64.87	24.92

Source: *Based on X Five-Year Plan Document, GoI*

3.1 Current grazing practices in the study areas

Agriculture and animal husbandry are interlinked in the study areas. Mixed farming and livestock rearing form an integral part of rural agrarian society. Fodder production and feeding practices are critical elements in the livestock sector. Livestock producers in the regions of Odisha and Chhattisgarh meet their requirements through a combination of crop residues, open grazing on common grazing lands, private lands, forests, fallow agricultural lands, harvested agricultural lands, and cultivated forage crops. The majority of farmers prefer grazing on common, fallow and forest land due to their easy accessibility.

The study villages are characterized by a prevalence of mixed crop-livestock systems. Almost all land owners own at least one or two animals. Small ruminants are most widespread among the landless. Land owners mostly keep cows, buffalos and oxen for agricultural operations (Figure 7). We observed that livestock-keeping in these areas is perceived more as asset ownership rather than as an income-generating activity. Most land owners own livestock to undertake agricultural operations and to produce farm yard manure (FYM), which is complementary to chemical fertilizer.

Figure 7
Prevalence of small ruminants and other livestock in the study areas

Figure 8
Paddy straw storage practice in Chhattisgarh and Odisha

Figure 9
Berseem production in large fields (L) and women carrying dry fodder (R) at Bhotipur Khurd, Rajnandgaon, Chhattisgarh

Figure 10
Transporting Berseem to dairy farmers in Bhotipur Khurd, Rajnandgaon, Chhattisgarh

3.2 Fodder production and management

The non-availability of sufficient green fodder throughout the year is the major constraint in both states. The major part of foraging resources in Chhattisgarh and Odisha comes either from by-products of wheat, rice, and other crop residue or from less nutritious grasses, leading to low production and productivity of livestock. The majority of the animals are reared under sub-optimal conditions due to shrinking grazing land, poor management of wasteland and grazing pressure per unit of land. In fact, poor livestock productivity is one of the major reasons for poor management, coupled with fodder scarcity and low value addition opportunities. The vast majority of livestock in these states would do well with the availability of nutritious feeds and fodder through proper scientific methods and breed improvement through artificial insemination.

Although farmers utilize crop residue as animal feed, the storage pattern for it varies from protective to open storage in fields (Figure 8). Rice straw is fed at home as a basal diet in most of these areas where green fodder is scarce. Stubble and ratoon left in fields after harvesting of rice are also grazed. Rice straw is poor quality feed in terms of protein and mineral content. It is high in lignocellulose and insoluble ash. Treating it by chopping and soaking and with urea have been successful under field conditions to enhance its nutritive content.

As per discussion with scientists of Chhattisgarh Kamdhenu Vishwavidyalaya, Durg and College of Veterinary Science and Animal Husbandry, Bhubaneshwar, different fodder varieties can be promoted in the study districts. A suitable mix of fodder/variety under each category of source (cereals, legumes, grass and fodder tree) can be taken up for fodder production (Annexure 4).

3.2.1 Economics of fodder production

Over the years, although various attempts were made to promote fodder production under field conditions, there has been a poor response from farmers.

In this context, various initiatives have been undertaken by different agencies (public, private, NGOs etc.) for promoting green fodder production and distribution of fodder seeds/root slips at both institutional and farmers' levels. These agencies are also involved in the establishment of fodder seed production farms and fodder nurseries to support the production and availability of improved fodder varieties. These farms also serve as demonstration and training units for fodder production and promotion. On similar lines, research and extension projects need to focus on promotion of community fodder production through integrated and participatory extension approaches.

3.2.2 Benefits and impact

We have estimated the cost and benefits of production of different fodder crops both in field conditions and on pasture land. The cost and economics assume that community members may not be interested in selling fodder, but the same cost can be saved by avoiding purchasing fodder from external sources. A majority of the suggested fodder varieties are perennial in nature, and

hence, income can increase in subsequent years with minimum investment. About one-fourth of the community land can be allocated for seeds or stem cuttings production. This land can also be utilized for promotion of fodder production, and the community members need to be encouraged to maintain the fodder crops and pastures.

The cost of production of fodder ranges from INR 6,000/ha to INR 47,500/ha depending on the type of fodder crop. The yield ranges between 8 tonnes/ha and 180 tonnes/ha; multi-cut sorghum and hybrid Napier grass yield more than 100 tonnes/ha. Berseem and maize are other potential fodder crops that can be cultivated with supplemental irrigation. Moreover, a combination of crops can be promoted in a single field, which reduces the cost of cultivation without reducing fodder yield (Annexure 5).

3.3 Lack of awareness of scientific cultivation of improved fodder grasses

In the study areas of Chhattisgarh and Odisha, farmers lacked awareness regarding cultivation of improved fodder grasses. However, a few farmers with irrigation facilities cultivated improved fodder grasses such as berseem over comparatively large holdings (2-10 acres) and sold it to dairy farmers at INR 2/kg (Figure 9 & 10).

Berseem has the following benefits: maximum land use efficiency as it is multi-cut in nature, with green fodder availability over a longer period of time, especially during the summer season; high green fodder yield (85 tonnes/ha), good forage quality (20 percent crude protein), high digestibility (up to 65 percent) and high palatability, leading to significant increase in milk production. Though the demand for improved fodder is increasing among dairy farmers, this could not be met due to a lack of irrigation facilities.

A few successful initiatives by NGOs have benefited a large number of farmers, especially in Chhattisgarh. For example, JK Trust has been involved in promoting improved fodder grasses through demonstrations and extension networks. The trust has established a number of fodder multiplication centres (FMCs), through which fodder seeds are provided to farmers throughout the year, together with practical demonstrations and training. Fodder Development Officers are posted in each FMC to guide farmers at the field level. Under the FMC projects, farmers are trained in urea straw treatment, Azolla cultivation, silage preparation, etc. to improve fodder quality.

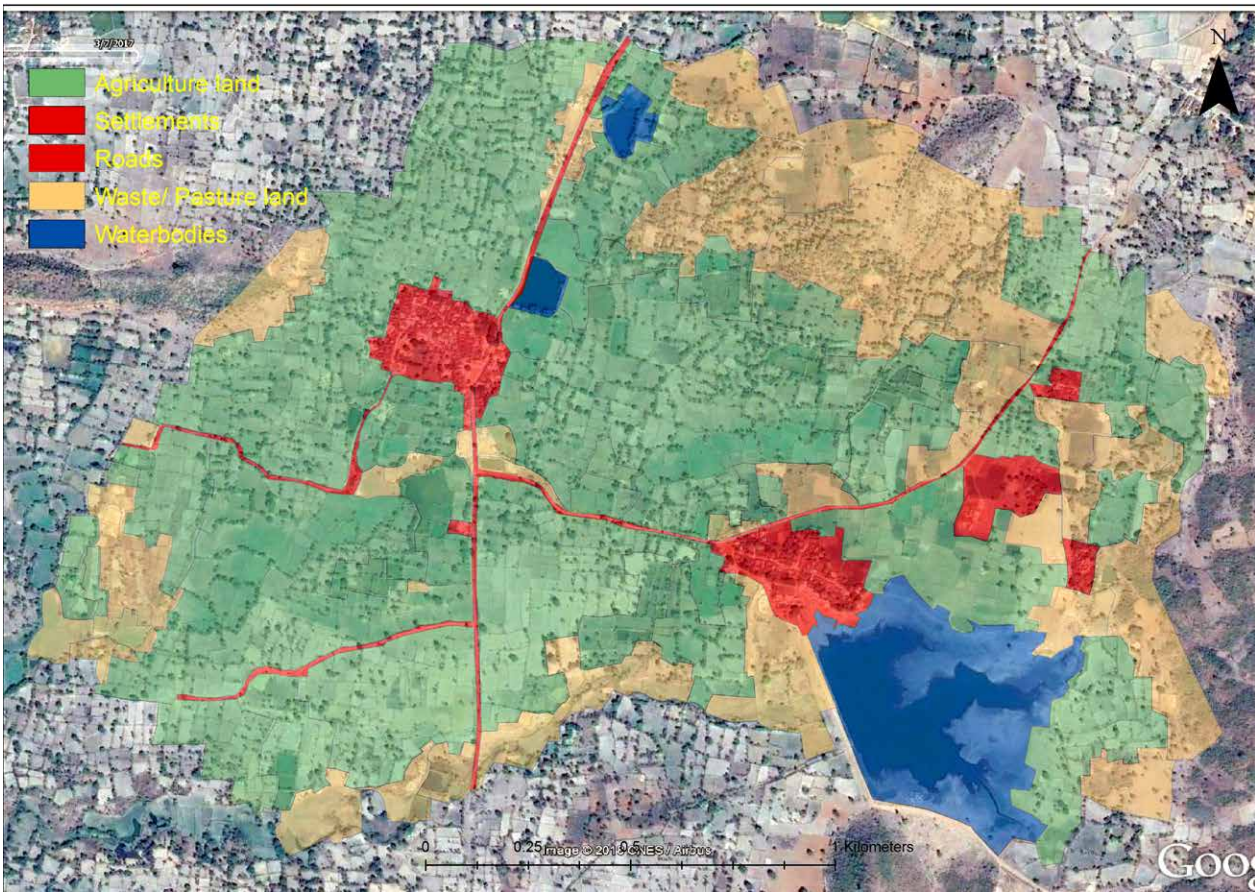
Community involvement in promoting improved fodder cultivation and creating awareness about feeding methods can address the problem of stray cattle. Farmers can be educated about nutritive fodder crops and enrichment of roughage through effective demonstrations.

3.4 Encroachment of common grazing land and low carrying capacity

Depending on the cattle population, about 5-50 ha has been given to every village in India for common community grazing of livestock (Deb Roy and Roy, 1996). Community grazing lands include panchayat grazing land, revenue and other wasteland, and degraded forest land that is illegally or legally used for grazing. As per the existing practice in both states, cattle are allowed to graze on pasture land. In some cases, farmers collect grass from the bunds and wasteland to feed their animals. The nutritional level of the pasture land is rapidly depleting due to over-grazing and depleting edible plant populations. In addition, grazing lands are being encroached upon, resulting in increased grazing pressure on adjacent forest lands and croplands.

There is thus a need to rejuvenate and maintain these pasture lands with nutritionally rich improved species with self-sowing abilities, so that animals are ensured quality pasture. Mapping of existing grazing lands using improved tools such as Geographic Information Systems (GIS) and remote sensing is useful for identifying and rejuvenating existing grazing lands. In the event of large-scale encroachment of common grazing lands, it is necessary that such lands are mapped and developed as protected grazing lands for effective livestock management. Figure 11 is an example of a land use map of Ghawdetola village in Mohla block of Rajnandgaon district in Chhattisgarh. It shows the grazing land available in the village. Extensive ground truthing of these lands can help identify the extent of grazing land being encroached upon that could be developed as protected pasture land for grazing.

Figure 11
Land use map of Ghawdetola village, Mohla block, Rajnandgaon, Chhattisgarh



Well managed grazing lands provide desirable vegetative cover, protecting the land from the erosive forces of water and wind. Plants on grazing land can be harvested as sources of biomass energy or as feed stock. Healthy grazing lands also provide additional benefits – water runoff on healthy grazing land is slow, so more water infiltrates into the soil, providing cleaner, more abundant water for wildlife and human use. The plant cover on grazing land also sequesters millions of tonnes of carbon, thus reducing atmospheric carbon dioxide.

For this study, pasture land development scenarios (shallow and moderately deep soil) were generated for three different rainfall regions – low, medium and high. In this analysis, the major impact indicators used were fodder yield, organic carbon and timber biomass. Various environmental benefits such as consumptive water use, fodder generation, carbon sequestration, timber biomass generation, and soil erosion control were estimated. Ecosystem goods and services generated were valued and net economic gain was estimated. Economic gain was estimated to be between INR 85,000/ha and 185,000/ha over the five-year period (Annexure 6).

A similar analysis on pasture land developed through the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in Rajasthan and Andhra Pradesh showed a net gain of 0.3-0.6 percent organic carbon compared to the nearby barren lands, equivalent to carbon sequestration of 7-14 tonnes/ha over a four- to five-year period. With an 80 percent survival rate of tree plants, nearly 2.5-8.0 tonnes/ha of wood mass have been developed in pasture land over the four-year period, equivalent to carbon sequestered of 1.0-3.0 ton/ha (ICRISAT 2016).

The carrying capacity of existing grazing lands both in Chhattisgarh and Odisha is decreasing due to the increase in livestock population and encroachment of grazing lands. For example, about 37 percent of the green fodder requirement (4328 tonnes out of 11835 tonnes) in Mohla block of Rajnandgaon is met by the existing grazing lands, whereas only 22 percent (2703 out of 12060 tonnes) is available in Chhuikhadhan block, Rajnandagaon district (Annexure 7). The remaining requirement is met through open grazing in fields. Therefore, it is necessary to identify (Figure 11) and rejuvenate existing grazing lands by controlling encroachments.

3.5 Scarcity of fodder resources and low productivity of local breed cattle

An analysis of feed resources in Odisha indicated that there was a wide gap between availability and demand for them (Figure 12). In 1992, the demand for feed resources was around 12 million tonnes; this grew rapidly to nearly 20 million tonnes in 2011 (National Dairy Development Board, 2016). Currently, the estimated availability of green fodder and dry fodder per year from all sources is 16.122 trillion tonnes and 31.204 trillion tonnes respectively. The present shortfall is 48.4 percent for green fodder and 23.5 percent for dry fodder (Government of Odisha, 2016). The current feeding management practices adopted by farmers for animals involve grazing and feeding on crop residue. Additionally, grain by-products are provided only to lactating animals (Figure 13). However, the nutrition available to the animals to attain their true genetic potential in terms of milk production is much below the requirement. The growing demand-supply gap is the result of a shrinking area under fodder cultivation and a lack of scientific fodder cultivation.

It was also observed that more than 90 percent of the cattle population is nondescript, yielding very little milk per day (0.5-1 litres/animal) compared to crossbred or improved breeds (5-10 litres/animal). Furthermore, in the absence of an effective milk collection network, farmers had no opportunity to sell surplus milk. Consequently, they had little interest in managing cattle efficiently or in availing of breeding services offered by the government and NGOs. Most farmers are unaware of the merits of artificial insemination and the advantages of crossbreeding. Those who were aware had lost trust in the technology due to repeated failures. Similar observations were made by Hegde (2010) while studying dairy husbandry in India. On the other hand, many of those who have adopted the technology are reaping its benefits. For example, in Singhola village, Rajnandgaon block, Chhattisgarh, farmers who had adopted artificial insemination now have improved breeds of cows yielding of 5-10 litres of milk per animal per day (Figure 14).

An interaction with a dairy farmer in Kodemara village, Mohla block, Rajnandgaon district revealed that effective cattle management has immense potential that complements agricultural income (Figure 15). The farmer owns 15 milch cows, which

Figure 12
Feed resources availability in TRFA districts, Odisha (Source: NDDB, 2016)

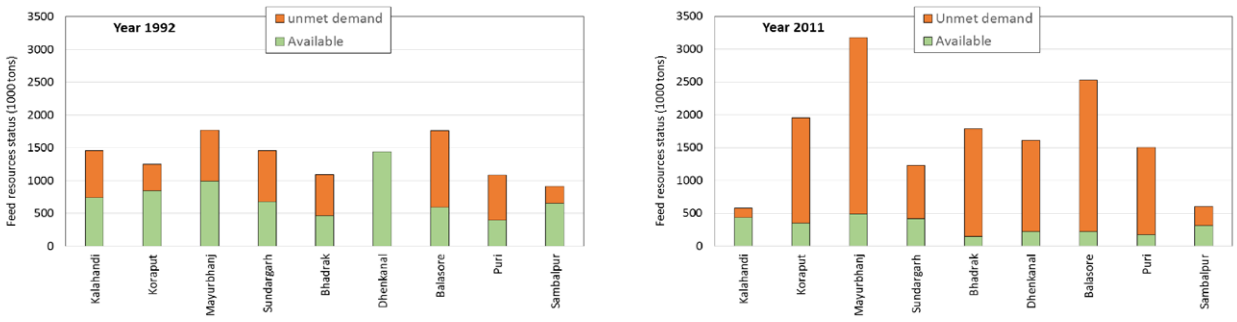


Figure 13
Feed resources and feeding habits in Mohla block, Rajnandgaon district, Chhattisgarh

Figure 14
Improved breed cows through Artificial Insemination in Singhola village, Rajnandgaon, Chhattisgarh

Figure 15
Mr. Eshwar Yadav - a dairy farmer in Kodemara village, Mohla block, Rajnandgaon district, Chhattisgarh

produce a daily average of 7-10 litres/animal. The milk is sold locally at INR 40/litre and used to prepare derivative products such as paneer, dahi, ghee, and sweets. He purchases mineral mixtures, green fodder as well as dry fodder for at least three months. This suggests that fodder availability, along with market linkages in the form of milk collection networks, goes a long way towards improving the livestock sector in these states.

3.6 Absence of community fodder production and social fencing

In a majority of the villages, the concept of social fencing is weak, and there are only isolated collective community efforts to control stray cattle. Farmers tend to own one or two cows and they manage their livestock themselves or through "charwaha". In some villages, the village committees decide informally, well before the season, when to start open grazing. They form a subcommittee with volunteers to guard the farms and even imposes penalties ranging from INR 100 to INR 1000 per animal on those who violate the norms. Most often, it is cattle from the neighbouring villages that destroy local crops, for which the committee imposes a penalty of up to INR 1000 per animal. Hence, there is a need to promote social fencing in all villages and create awareness about better ways to manage livestock and crops. This is possible with well-developed common property resources.

3.7 Community-based efforts to address fodder security and stray cattle

Isolated yet significant community-based efforts exist for cattle and fodder management in

Chhattisgarh and Odisha. Farmers themselves ensure institutional involvement to effectively manage the livestock population, with the local people setting informal rules and responsibilities. In such community-driven arrangements, every member takes responsibility for adhering to the rules and regulations (Saxena et al., 2001). These are a few of the community-driven arrangements in the study areas:

3.7.1 Charwaha system

In a majority of the villages in Chhattisgarh and Odisha, traditional community-based and farmer-driven solutions for livestock management exist, such as the charwaha/gwala (livestock caretaker) system (Figure 16). In this system, one or more caretakers are identified in a village, depending on the livestock population. Each charwaha is responsible for 50-100 animals for a period of four to nine months, depending on the local arrangements (Table 6). This collective community arrangement substantially helps tackle the problem of stray cattle. The system is comparatively strong in Odisha, where livestock is managed for nearly nine months, compared to only four months in Chhattisgarh. This means that the wage rate too differs – 40 kg of paddy per animal for four months in Chhattisgarh and 80 kg of paddy per animal for the entire year, or a monthly rate of INR 100/animal in Odisha (Table 6).

Discussions with the farming community during field visits revealed that the problem of stray cattle is limited in Odisha, where the charwaha system is in effect until March, compared to Chhattisgarh, where the system ends by November. Moreover, nearly 20 percent of the surveyed villages both in Chhattisgarh and Odisha do not follow this system, as the farmers themselves take care of their cattle. However, farmers in Chhattisgarh are keen that the charwaha system be extended up to March-April instead of only until October-November, so as to accommodate rabi crops.

3.7.2 Field fencing and employing chowkidars

A good fence provides a physical barrier to restrict the movement of animals in and around the farm. In areas where stray cattle are rampant, farmers invest in suitable fencing around the field. A majority of fields were fenced using either stones/cement poles and iron cables or semi-pucca structures consisting of wooden poles and iron cables. The estimated cost of fencing with stone/cement poles and barbed wire was INR 1,50,000 per ha.

Table 6
Duration and payment system under Charwaha system

States	No. of Months	Wage rate	Remarks
Chhattisgarh	4 months	40 kg paddy/animal	No charges for below 2-year-old calf
Odisha	9 months	INR 100/animal/month or 80 kg paddy/animal/year	

Figure 16
Open grazing of cattle by a charwaha in Khairagarh block; cattle resting place in Gopalpura village, Chhuikhadan block, Chhattisgarh

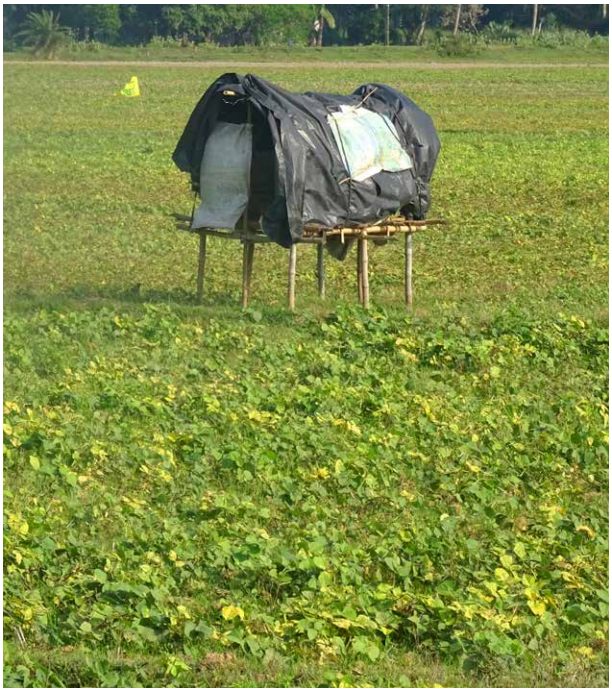
It is heartening to note that a few NGOs have been involved in promoting individual as well as community fencing, providing incentives such as cost sharing up to 50 percent. For example, the NGO Pragati in Koraput, Odisha, which has been engaged in promoting such fencing with the help of Tata Trust and FPOs, has seen great demand from farmers. In the Chhattisgarh study area, some farmers have invested considerably in field fencing (Figure 17) to protect crops. However, during the study visit, there were many requests from farmers for field fencing, which a majority of farmers can't afford to invest in.

Farmers in both Chhattisgarh and Odisha use a combination of fences. In Chhattisgarh, both non-living fences (made of wood, barbed wire and rocks) and live fences (like hedgerows, trees, etc.) are common, along with combinations of hedgerows and barbed wire (Figure 17). With the state government promoting the cultivation of plants such as Jatropha (Jatropha curcas) on field bunds for biodiesel, these plants are also now being used as live fences along with barbed wire.

In Gopalpura and Shilpatti villages in Chhuikhadan block, Rajnandgaon district, social fencing is practiced. In this arrangement, before the start of the season, village elders, either through village committees or temple committees, propose rules and regulations on managing stray cattle, when to start open grazing, and the fines to be imposed. Though effective, this arrangement needs to be strengthened.

Figure 17
Field fencing for protecting field from stray animals in Chhattisgarh

Figure 18
Building of small huts for guarding rabi crops in Puri district, Odisha



Farmers keen on effective ways of protecting their rabi crops from stray cattle and wild animals also make huge private investments in employing a chowkidar (watchman) at least during critical crop periods, paying them a minimum wage of INR 180/day. Although under TRFA there is a provision to engage two raskhaks or scouts to protect crops, farmers have not taken to this scheme. Therefore, many farmers pay out of their own pockets to engage chowkidars to guard their fields during the night (Figure 18). This practice of engaging chowkidars needs to be aligned with the TRFA scheme of engaging rakshaks/scouts.

3.7.3 Community farming

Community farming is gaining importance in areas where labour scarcity is severe. In Chhattisgarh and Odisha, community farming models have been developed and promoted by research organizations and NGOs to address the labour scarcity and, to some extent, the problem of stray cattle in rice fallows. This involves the use of a pool of resources such as land and manpower, enabling the community to afford modern technology that the farmers cannot afford individually. Indira Gandhi Krishi Vishwavidyalaya, Raipur set up a model community farm on about 65 ha of land in

Figure 19
Blackgram and greengram demonstrations under TRFA in Shakigopal block, Puri district, Odisha

Jarebendari and Bolbola villages, Bastar, with 61 farmers' fields fenced to protect them from open animal grazing. On this land, 16 borewells, 10 open wells and 3 stop dams have been constructed to increase irrigation. Agricultural implements such as wheel hoes, weeders, sprayer, drip/ sprinkler systems, etc., and improved seed have been provided. The model has generated about INR 1,75,000 net income per hectare and has led to crop diversification (Rathore, 2018). Promoting community farming models in rice fallows could benefit a large number of farmers and help control the menace of stray cattle.

3.7.4 Solar-powered fencing systems

Several agencies, including governments, have devised a variety of strategies to protect crops from wild animals, but the problem still persists. Therefore, alternative methods are needed to protect against crop damage. Solar-powered fencing is seen as an alternative to conventional fencing methods. In this method, the fence is similar barbed wire fencing, with multiple strands of plain wires and metal/cement/wooden posts to hold the strands in position. The wires carry high-voltage current and give a sharp, short but a non-lethal shock to any intruder that touches them, creating psychological fear to dissuade any tampering. An alarm incorporated into the system also gets activated and alerts the inhabitants of the protected area. These are tailor-made fences and can be designed according to customer needs and site condition.

An approach paper by National Bank for Agriculture and Rural Development (NABARD) (https://www.nabard.org/demo/auth/writereaddata/ModelBankProject/1612162331Solar_Fencing_(E)_in_Himachal_Pradesh.pdf), while estimating the cost and benefits of the system, highlights the advantages of solar fencing over other fencing and over regular electric cables. In the solar fencing system, the pulsating current will not grab the animal, which generally happens with continuous current and which causes contraction of muscles/cramps, preventing the animal from moving away and leading to electrocution. In solar fencing, even if an animal is trapped in the fence, after 10 consecutive shocks the system will trip and a hooter will sound, so that the farmer can intervene and no death is caused. In this system, wire spacing and fence design can be modified to control a variety of animals. Electric fences can last a long time (up to 40 years) when built with quality components and materials. The new system of solar fencing also runs on batteries that are charged by solar panels. In case of 24-hour fence operation, the battery and solar panel are appropriately sized. An alarm unit accompanies the system for intruder detection.

NABARD (2016) estimated the unit cost for five different models, starting from 1 acre to 20 acres (Table 7 & Annexure 1). It found that higher area models are suitable for groups of farmers and models 1 to 5 are not financially viable if farmers grow food grains. However, these are viable if farmers grow cash crops like vegetables and fruit crops (Table 8 & Annexure 2). Some state governments, such as Goa and Telangana, are promoting solar fencing systems by offering a subsidy of 50-90 percent to protect crops from wild animals.

Table 7
Unit cost of solar power fencing models

Model	Protected area (acre)	Perimeter for fencing (metre)	Unit cost (INR)	Cost per running meter (INR)
Model 1	1	300	161907	540
Model 2	2.5	500	210793	422
Model 3	5	700	259679	371
Model 4	10	1000	407716	408
Model 5	20	1400	505489	361
Source: *NABARD, 2016*				

Table 8
Economics of investment of different models

Model	Protected Area (acre)	Internal Rate of Return (IRR, %)			Benefit Cost Ratio (BCR)			Net Present Value, (NPV, in INR)		
		Food grain	Vegeta-bles	Fruit crops	Food grain	Vegeta-bles	Fruit crops	Food grain	Vegeta-bles	Fruit crops
Model 1	1	16	>100	88	-0.23	2.61	1.28	-189443	248193	42424
Model 2	2.5	31	>100	>100	0.24	5.69	3.13	-152786	941306	426882
Model 3	5	57	>100	>100	0.87	9.72	5.56	-31813	2156370	1127522
Model 4	10	89	>100	>100	1.36	12.63	7.33	141487	4517853	2460158
Model 5	20	>100	>100	>100	2.67	20.85	12.30	805008	9557741	5442351

Assumptions: i) For estimating the economics, 40 percent crop loss is assumed; ii) Economics has been worked out for solar fencing investment in three scenarios, where farmers grow food grains, vegetables and fruit crops; iii) Discounting factor of 15 percent is assumed.
Source: NABARD, 2016

3.8 Poor agronomic practices and resource use efficiency

Apart from the menace of stray cattle in rice fallows, agronomic practices such as the predominance of kharif paddy till the end of November and mid-December are a critical factor that affects establishment of the second crop. The late harvesting of rice occurs due to inadequate soil moisture during the rabi season.

Short-duration rice cultivars such as RNR 15048, DRR DHAN 43, 44 (120 days) and PRATUSHA and RAKSHA (100 days) need to be promoted to make use of the window of 10-15 days that is favourable for germination and early establishment of a second crop. This window will provide scope in 25 to 30 percent of rice fallow fields to maximize fodder and grain production, providing additional income to households. Similarly, promoting simple machines like the zero-till multi-crop planter that can sow the second crop directly in the rice fallows at the required depth can help avoid the loss of moisture in land preparation and sowing.

A major concern among the majority of farmers in both the states was a lack of timely availability of seeds and other inputs, which deters timely sowing in rice fallow areas. Often, farmers have to then depend on local cultivars, which are low-yielding and prone to pests and disease. However, efforts are being made through TRFA to promote improved varieties of pulses and oilseeds, such as green gram (IPM 2-14), black gram (PU 31), lathyrus, lentil and chickpea (JAKI 9218, JG 11, Vishal, JG 64) in Chhattisgarh; and green gram (IPM 2-14), black gram (PU 31), sunflower, groundnut and chickpea (JAKI 9218, JG 11, Vishal, JG 64) in Odisha.

While appropriate seed planting rates in pulses (e.g., groundnut, soybean and chickpea) can significantly enhance crop yields, high seed costs and the prospects of low rainfall or soil moisture that directly affect seed germination tempt farmers to adopt a low seed rate, resulting in sparse population and low productivity. Also, faulty sowing methods, like broadcasting, which is adopted by most farmers for rabi crops, is a major stumbling block in seedling establishment. Moreover, broadcasting calls for a higher seed requirement but often results in poor seedling growth.

In the case of crops like green gram and black gram (Figure 19), farmers opt for broadcasting, which leads to poor germination due to lack of soil moisture. Thus, a short sowing window coupled with the non-availability of suitable machinery leads to a vicious circle of high seed rate, poor growth and high cost of operation.

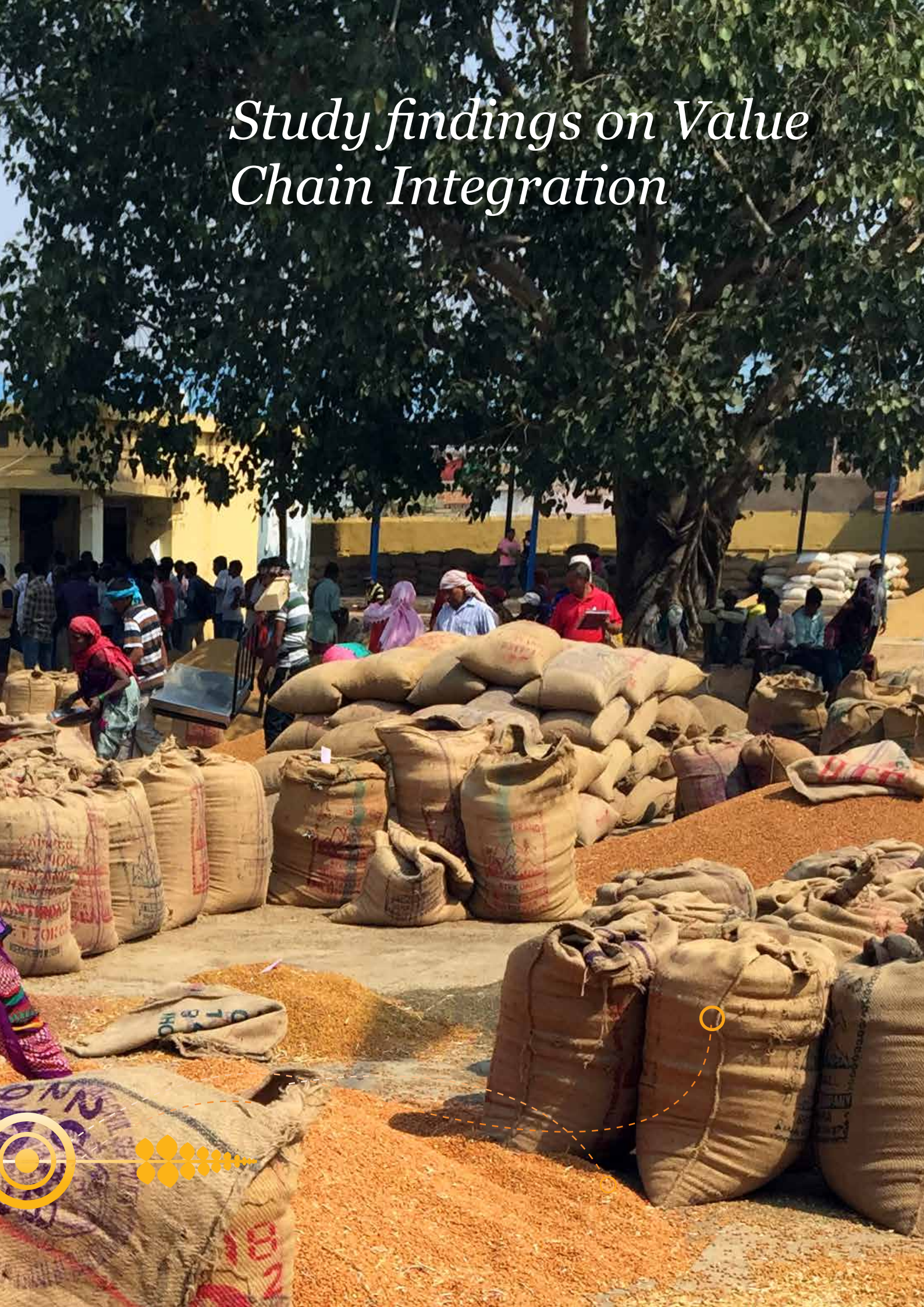
During focus group discussions, farmers expressed the need for schemes like TRFA to be implemented

in all the villages so that farmers become more aware of improved cultivars. Lack of irrigation facilities is a major constraint in rice fallows during the rabi season, leading to intermittent cultivation (non-continuous areas), resulting in crop damage by stray cattle and wild animals. Timely availability of inputs such as seeds and fertilizer is also critical to bring more area under rabi cultivation and ensure sustainable crop production.

3.9 Lack of convergence efforts among line departments

In terms of administrative arrangements, separate line departments in each state government deal with fodder and livestock production. Fodder development is the joint responsibility of several agencies, as it involves both crop residues and forest species. However, there are no efforts on the ground to converge existing programmes to ensure fodder availability. Each agency is driven by its own set of guidelines to meet targets. Hence, there is a need to strengthen convergence of forestry, agriculture, and watershed development programmes with pastures and grazing land management in forests, nonconventional forest areas, village common lands and other potential areas (Planning Commission, 2011). The interconnectivity between the different line departments needs to be recognized.

Study findings on Value Chain Integration



The success of India's food security efforts over the past four decades that transformed the country from a food deficit region to a food surplus state was possible because of a coordinated effort by various Ministries of the Central and State Governments and private industries associated with agricultural development. This coordinated approach was underpinned by systematic steps to develop an efficient value chain. At the end of this value chain was a market that was dominated by the public procurement system. However, the integration of the public market into a formal agricultural market has remained the weakest link in the evolution of India's agriculture economy.

The National Commission on Agriculture defined agricultural marketing as a process that begins with the decision to produce saleable farm commodity and ends with that commodity reaching the consumers. Expressed differently, it is a complete value chain with backward and forward integration that brings all the stakeholders on to a common platform to add value to the produce while working to reduce the cost of transactions. Although the general perception of agriculture marketing is the disposal of surplus produce, the challenge lies in incentivizing small holder farmers to accelerate their agricultural production through a fair market environment closer to the point of production.

Physical connectivity to markets is a necessary criterion for the success of small holder farmers, as the Indian agriculture scenario is constrained by decentralized production by millions of farmers and the fragile and bulky nature of the produce, which is seasonal in production while the demand is spread all round the year. Most farmers grow crops that can be conveniently grown, depending on the season and available inputs, without understanding the demand for the produce. As the crop marketing efficiency for Indian farmers has been poor due to inadequate infrastructure, weak information systems, outdated policies, unscrupulous traders and unfair practices, helpless farmers are exploited to such an extent that cultivation of many crops is becoming an uneconomic activity, sometimes leading to dire outcomes.

The study findings on VCI describe the prevailing ecosystem in Odisha and Chhattisgarh that is available to integrate the small holder farmer into existing markets. Examples of where things are working and where improvements could be made are brought out using information from the semi-structured field interviews. Critical elements of VCI are covered in the findings – presence of post-harvest infrastructure, availability of agro-logistics, easy credit for the harvested crop, presence of market actors like traders, processors, retailers, consumers, etc. to enable transactions to take place. The role being played by the government in enabling VCI is also discussed.

An exploratory study, like this one, serves as a very good starting point to describe the conceptual frames within which the value chain actors operate and the drivers to specific activities that can lead to chain integration of small holder farmers. The operational frame presents an opportunity to recommend systemic interventions that have the potential to accelerate the journey to the desired outcome of achieving complete VCI of the small holder farmer within the TRFA. A more comprehensive study, backed with extensive data collection (primary and secondary) will be required to recommend nuanced approaches specific to the geography and individual crop type.

The field visits and consultations were held with more than 200 respondents, one-third of whom were farmers. Key informant interviews were done with actors across the entire value chain of pulses, starting with production and ending with retail marketing. The consultations were held over 15 days of field visits covering seven districts of Chhattisgarh and Odisha. Three of the seven districts covered are outside the TRFA Scheme implementation in 2017-18. These districts have representation of VCI activities and were selected as per the advice of PIC members and state government officials.

The VCI section of the study findings is divided into three parts. Sections 4.1 (and its subsections) and 4.2 (and its subsections) bring out specific observations on post-harvest/processing infrastructure and the current role being played by the state governments in integrating small holder farmers to value chains in Odisha and Chhattisgarh. The field observations are detailed as a narrative of discussions with different stakeholders in Odisha and Chhattisgarh. Section 4.3 presents a summary of observations on VCI. It proposes a conceptual framework that encapsulates the observed VCI in pulses and a comparison of the behavioural responses of small and marginal farmers and medium-large farmers across the different elements of the value chain activities and their likely impact on VCI.

4.1 Study findings: Odisha

As noted earlier, Odisha has been implementing the TRFA scheme since the inception of the programme in 2016-17. In its second year of implementation in the state, the department faced several challenges, and most of these have been linked to production and the limited availability of marketable surplus at the level of the individual farmer. The paragraphs below describe observations on market linkages, availability of post-harvest infrastructure, the public procurement system, etc.

4.1.1 Market linkage and post-harvest infrastructure

Field discussions were held in project villages in Sakhi Gopal Block (Puri district) (Figure 20), with farmers in Khordha district (abutting Puri district) and with farmers in Koraput district in southern Odisha. These farmers were growing pulses and oilseeds. The farmers were of the view that while the government declares a minimum support price (MSP) for pulses, there is little or no off-take at those prices. The MSP is meant as a safeguard for farmers, to ensure that the farmer makes a certain minimum profit through government procurement even if prices in the open market are lower than the cost price. However, in reality, farmers are forced to sell at the prevailing market prices, which are lower than the MSP. Many farmers had diversified into multiple crops, including horticultural produce. Some farmers were able to take their horticultural produce to Bhubaneswar, while others had to sell to the local village-level integrator.

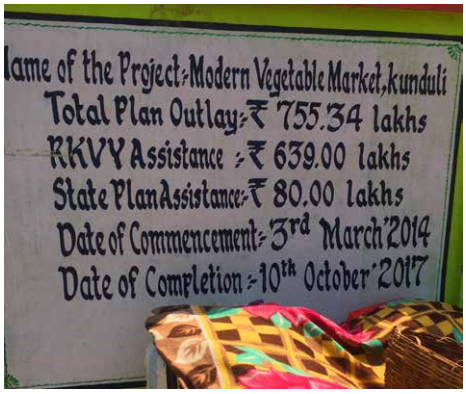
Development of pulses in Koraput district, a predominantly tribal region in southern Odisha, under the TRFA scheme, has been done across all 14 blocks of the district. The district agriculture department planned demonstration trials on 3000 hectares for two varieties of green gram. The results of the demonstration – yield, impact on farmer adoption, etc – are awaited. Informal feedback indicates that there has not been good acceptance of the variety that was used for the demonstration trials.

Progressive farmers working in these districts brought out the need to build a quality mindset and also a mechanism to train farmers in ensuring quality at the farm gate. Appropriate infrastructure (such as primary sorting and grading, short-term storage) needs to be created at the farm gate or the village level, to be used on a 'pay-per-use basis', in order to clean the crop before it is sold or kept in storage. Not many were aware of the presence of e-NAM (Electronic National Agriculture Market) (Figure 20).

Koraput in Odisha is also a very large hub for trading of all types of agro-commodities grown in and around the region. Traders/buyers come from Andhra Pradesh, Chhattisgarh and Bhubaneswar to trade in Koraput. Kundli Haat, located in Pottangi Block of Koraput, is being developed as a regional hub for trading of fruits and vegetables (F&V). This market is being developed as an e-market for the district. Indian Farmers Fertilizer Cooperative Limited (IFFCO), the country's largest farmers' cooperative, has already funded the development of the physical infrastructure

Figure 20
e-NAM Market in Sakhi Gopal, Puri district, Odisha

Figure 21
IFFCO Supported Market Yard Koraput, Odisha



(Figure 21). As a first step, IFFCO will also provide extensive services on input supplies to over 8000 farmers in the Pottangi and Semiliguda Blocks. (https://www.indiaagronet.com/Agriculture-Market-News/Iffco-Will-Open-e-bazaar-at-Koraput-Market.html)

Discussions across different value chain partners indicated a mixed response to approaches being deployed in creating FPOs in the state. The requirements to establish an FPO were seen as very onerous and the available resources (skills and money) are inadequate to sustain this initiative.

Dal (pulses) millers from Jatni Block of Khordha district indicated that the supply quality of pulses needs to match with consumer demand and what can be grown in the region (Figure 22). Farmers are supplied seeds that don't perform well in the field, and as a consequence, there are quality rejects. Interactions were also held with processors and small oil expellers (micro/cottage) in Begunia Block of Khordha district, who were processing multiple crops – paddy, wheat and oilseeds. These processors would receive raw material from growers/aggregators located within a radius of five kilometres. Most of the processed product was sold in local village retail outlets or was meant for self-consumption.

Figure 22
Medium-scale private dal mill and value-added products

Processors were not aware of the requirements under the norms of the Food Standards and Safety Authority of India (FSSAI). There was very little evidence of quality control or of compliance to any established standards. Operators did not find the dal- and cereal-processing business lucrative. The business faced several constraints like absence of capital, difficulty in getting supplies for processing, poor infrastructure (such as electricity), and competition from branded products sold by large companies.

Interviews with several NGO partners yielded encouraging inputs. These NGOs support production and value chain activities like aggregation, postharvest handling and processing in different parts of the state. All NGO partners were in alignment with the objective of finding better market opportunities for the farmers' produce and the government schemes to promote small milling (dal, rice, millets, etc.), and agreed that there was an urgent need to increase farmer awareness of these schemes. Small equipment for pulverizing, grading and sizing was seen in different lead farmer households (Figure 23).

4.1.2 Public procurement platforms

The agriculture markets in Odisha are not as developed as those in other states, and market arrival data of crops other than paddy was not available. Under a 12-point programme of the Chief Minister, Krushak Bazars (Farmers' Markets) were set up to help farmers to sell their produce directly to the consumer, as is done in some other states, where these are called APNI Mandi, Rayatu Bazar etc. The Krushuk Bazars are mostly used for selling horticultural produce. About 43 Krushuk Bazars were established in the state at different locations under some of the regulated market committees (RMCs) with basic infrastructure facilities, of which 32 are functional. Steps are being taken to activate all the Krushak Bazars.

Figure 23
Interaction with NGO field staff and small-scale processing equipment for cereals

Odisha state produces 95 lakh tonnes of paddy. 75 percent of this volume is bought for custom milling for supplies through the Public Distribution System (PDS) and the remainder is bought by the Central Government through the Food Corporation of India (FCI). Paddy procurement happens through Primary Agriculture Cooperative Societies (PACS) supported by RMCs. Wherever the PACS don't have infrastructure, the RMC provides resources like space, primary cleaning, weighment, etc. to ensure that paddy is tested for compliance with the procurement norms.

The FoodOdisha platform offers traceability of production and procurement and processing of paddy procured through the state system (Food Portal, Odisha website). The Food Supplies & Consumer Welfare Department manages this portal, which was developed in 2014. Details of all farmers and millers are maintained in this system. Production and delivery by farmers is confirmed after checking the quality as per the state government norms. The electronic confirmation of the same is treated as a receipt and the state exchequer electronically transfers the payment to the farmers. The state also procures pulses for the national system for distribution via the PDS or price stabilization. The system design and transparency match what could be expected from a well-designed supply chain IT system.

The state's agriculture marketing system, Odisha State Agriculture Marketing Board (OSAMBOARD), is the nodal agency responsible for developing and maintaining all public infrastructure related to agriculture markets and market linkages for producers. This agency is part of the state's Cooperation Department. In the context of marketing of TRFA production in Odisha, there was no data available. The state agriculture department is the primary department responsible for implementation of the TRFA scheme. The agriculture department and OSAMBOARD did not appear to have a coordinated approach to address the requirements of building market linkages for the surplus crops being produced under the TRFA scheme.

4.1.3 State government's structural initiatives on VCI – enhancing market linkages

The state government has embarked on a range of initiatives to build on the existing marketing infrastructure with the objective of enhancing VCI of small and marginal farmers. The details presented below highlight some of the key steps being undertaken to ensure timely implementation of these initiatives.

As a means of preparing the state agriculture marketing system to handle the emerging needs of the citizens, OSAMBOARD is in the process of an extensive overhaul. The objective of the reorganization is to make the organization ready for the emerging value chain institutions like FPO, e-NAM, NCDEX, etc. The state will also review the model Agricultural Produce Market Committee (APMC) Act and recommend implementation of relevant elements for the state, keeping in mind the overall objective of doubling farmers' incomes.

The state government is building infrastructure to support commercial value chains in food and agriculture. The state has 10 agro-climatic zones, giving it the potential for a wide range of crops that could be commercialized over time. In the meeting with Principal Secretary, Agriculture, we discussed leveraging the natural resource base of the state for doubling farmers' incomes. The state is developing a new project titled Micro Production Cluster for Aggregation. This programme is being piloted in 36 blocks across 10 districts of the state. The agriculture department will be working with a wide range of non-government actors, including NGOs and the private sector, for implementation. This is expected to be the backbone of a longer-term plan to build VCI for smallholder farmers in the state.

The decision-making tools at the state Agriculture Department are being upgraded for near real time provision of data to ensure timely action in response to farmer needs. ADAPT – Analytics for Decision-Making and Agricultural Policy Transformation is a platform being developed with support from the Bill & Melinda Gates Foundation (BMGF) that will provide online information to department officials on the status of policy implementation at various levels of administration. The platform will be operational in 2019.

From the discussions with officials of the state, it is clear that appropriate systems are in place to transparently procure and process key crops. Additional steps, as described above, are being undertaken to enhance market access of small holder farmers and integrate them into market-oriented value chains. Coordinated and timely action between the Department of Agriculture and OSAMBOARD is required to leverage the existing system and related infrastructure of PACS and RMCs to procure surplus pulses that are produced under the TRFA scheme.

Figure 24
Pragati, an NGO, working in farm livelihood training and agriculture value chain

4.1.4 State government's policy initiatives on VCI – building programme convergence

The Odisha Rural Development & Marketing Society (ORMAS) is responsible for all the activities of the Odisha Livelihood Mission for the state. They have introduced several schemes that will enable access to finance for building storage infrastructure at the Gram Panchayat level, acquiring machines for value addition, skilling of local people, etc. These schemes are locally devolved and funds can be sanctioned very quickly. Small private sector entities and start-up enterprises are procuring non-timber forest produce (NTFP), pulses and millets from farmers. These enterprises are investing in physical infrastructure for building a supply chain that will ensure timely production, storage and primary value addition near the farm gate (Figure 24). Standardization and quality assurance are being introduced and some private enterprises are also selling the produce as branded products on Amazon. If given an assured supply of surplus, these entities could potentially partner for scaling up and for delivering TRFA pulses to the urban and peri-urban markets.

In 2016-17, the Odisha government introduced a bold initiative titled Odisha Millet Mission. This is a five-year programme with a budget of more than INR 500 crores, with a focus on increasing production and consumption of "nutri-cereals". The key focus areas are: improving production, increasing local (producing village) consumption of millets by 25 percent, and making marketable surplus available for fast-evolving urban markets. The mission is actively engaged with value chain partners on technology, product development and building market access.

4.2 Study findings: Chhattisgarh

Chhattisgarh state, like Odisha, was in its second year of implementing TRFA. The state's performance, as reported earlier in Section 1.2, has been exemplary. The area coverage in five districts of TRFA pulses across 427 villages was 4.48 lakh ha, which exceeded the planned coverage of 2.8 lac ha. Chhattisgarh has three agro-climatic zones – the Chhattisgarh plains (51 percent of landmass), the Bastar Plateau (29 percent of landmass), and the Northern Hills (21 percent of landmass). Almost half of the Chhattisgarh landmass is forest area and only 36 percent of the land area is available for cultivation.

4.2.1 Market linkage and post-harvest infrastructure

Farmers are largely dependent on paddy cultivation in kharif as a means of livelihood. The state procurement system is tuned to procure paddy, and to have it toll-processed and supplied to either the national food security stocks or distributed to the Below-Poverty-Line (BPL) population in the state. The state is rich in NTFP, in several types of millets, and some pulses and oilseeds. Over a third of the state's population is tribal and they follow locally appropriate agricultural practices. Most of the crop produced is for self-consumption and any surplus is usually barter-traded within the village or the extended community.

Bhatapara Mandi (located in Balod-Bazar district, a non-TRFA district) is 120 km northeast of Raipur and is a designated e-NAM market (Figure 25). Most of the trade in the market continues to be through the traditional auction mechanism. The electronic trade and related infrastructure for

Figure 25
Bhatapara, Balod Bazar district e-NAM market

quality assaying exists in the mandi, but is being sparingly used. Village traders, large farmers and local agents were participating in open auctions.

Several processing units for dals and rice are located near the mandi (Figure 26). Millers indicated that they would buy from the mandi and also directly from the farmers/traders (outside the mandi) using the 'Sauda Patrak' system. The buyer and seller have to report the trade to the mandi and deposit the appropriate fee/tax.

During discussions with the owners, it was learnt that the equipment in these mills uses relatively old (over 25-30 years) technology. Process efficiencies are low and compliance with FSSAI norms is extremely limited. The millers don't have the incentive to invest in modern technology as their returns (profit margins) are very erratic due to the volatile market prices of pulses.

Figure 26
Dal mill, Bhatapara, Balod Bazar district

Figure 27
Farmer one-stop shop, Rajnandgaon Mandi, Rajnandgaon

Interactions with dal millers from the Raipur area also revealed the need for VCI within the state. Processors are dependent on raw produce from outside the state in order to meet their demand. They have expressed keenness to work closely with the agriculture department to support farmers in increasing pulse cultivation.

Rajnandgaon district, located in the western part of the state, borders with Maharashtra and Madhya Pradesh. Traders often come to the Rajnandgaon Mandi from across the state. The district is known for its production of high quality *poha* (flattened rice) that is used for making various savoury dishes. There are several food processing units located in the district, and it is also known for processing cereals, poultry, horticulture crops, oilseeds, etc. The Agriculture mandi located in Rajnandgaon is also a designated e NAM market. However, like Bhatapara, most of the trade is done through the traditional auction system.

The ***mandi*** complex has integrated a one-stop farmer shop that is being run by an entrepreneur. The shop offers all the possible requirements of inputs (equipment, consumables, etc.) to the farmers who come to trade at the *mandi* or the town centre for any work (Figure 27).

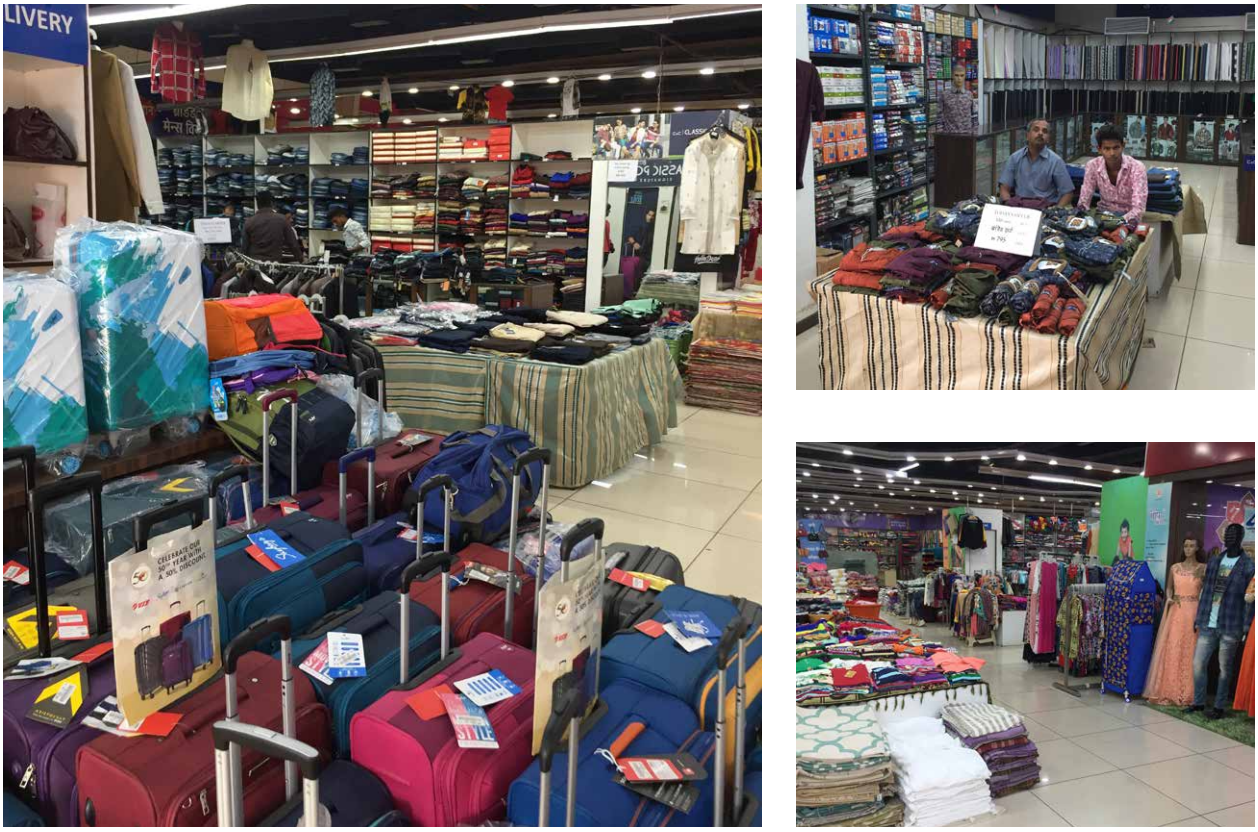
In addition to providing services for trading and for acquiring agricultural inputs, the farmer one-stop shop also offers advice on crops, seeds, etc. They are also planning to establish a farm equipment service centre at the block level so that farmers don't have to worry about minor repairs. The establishment of this facility displays a very forward-thinking approach from the mandi officials.

In order to attract the families of farmers, the mandi has also allotted space for a modern retail outlet (department store) and a movie theatre. These are run by private enterprises and the aim is to attract farmer families to the area while the farmer is completing his business at the *mandi* (Figure 28).

4.2.2 Public procurement platforms

Marketing is done through Krishi Upaj *Mandis* (regulated markets run by RMCs). There are 73 listed mandis and 112 sub-mandis. However, during field visits and discussions with traders, it became clear that only handful of these *mandis* were functional. There was unanimous agreement that the RMCs have very limited reach – they are mostly restricted to village traders and large farmers.

Figure 28
Departmental store and cinema for villagers, farmer families, etc., Rajnandgaon Mandi, Rajnandgaon



Discussions with progressive farmers brought out the need to build a quality mindset and also a mechanism to train farmers in ensuring quality at the farm gate. Appropriate infrastructure needs to be created at the farm gate or at the village level, and this can be used (on a pay-per-use basis) to clean the crop before it is sold or kept in storage (Figure 29).

Focus group discussions were held with farmers in project villages and interviews were conducted with farmers who had brought their produce to the *mandi*. Farmers were growing chickpea, which they would sell to the village aggregator (often the large farmer) or directly to the *mandi*. In some locations, small godowns were seen, which were funded under the NFSM programme. Here too, the farmers were of the view that while the government declares an MSP for pulses, there is little to no off-take at those prices. As a consequence, the farmers

Figure 29
Field discussion in Raipur TRFA district

are forced to sell at the prevailing market prices, which are lower than the MSP.

TRFA implementation in Raipur district has shown some results though there was no concrete data available on the inputs and the outputs achieved. Further, given that Raipur district is mostly urban, farmers are gradually abandoning farming, as there is no labour available. Farmers find it more lucrative to sell their land and seek non-farm employment.

The Department of Agriculture and also the Department of Food & Civil Supplies uniformly expressed a sense of urgency to address the issues arising from poor long-term sustainability of dependence on kharif rice production. Both were of the view that appropriate local institutions need to be nurtured in order for any meaningful value chains to emerge. Further, sustained availability of surplus produce at the farm gate is essential to encourage transactions beyond the kharif season. The state procurement system is geared to buy pulses from the farmers. There needs to be appropriate policy action to ensure convergence of agriculture and marketing. For the year 2018-19, the state proposed to buy chickpea for distribution to select districts as part of the state food security mission. Approximately 60,000 tonnes are to be bought, and tenders for the same will be floated using the MARKFED system.

4.2.3 State government's policy initiatives on VCI – building programme convergence

The State Rural Livelihoods Mission (SRLM), with support from the National Rural Livelihoods Mission (NRLM), is working with national-level teams to build VCI and improved market access for crops in some of the aspirational districts. The state's Mandi Board has engaged with consulting firm Ernst & Young to build linkages, both backward and forward, for select agricultural produce from the state. Road shows (marketing events) are being organized by bringing in large buyers, agri-produce companies and processors from outside the state to showcase the state's capabilities.

Bhoomgadi Organic Farmer's Producer Company, located in the predominantly tribal district of Dantewada, is leveraging funds from the tribal development budget as well as district mining royalties to create sustainable value chains for the local people. The Bhoomigadi FPO is a sterling example of VCI (https://timesofindia.indiatimes.com/city/raipur/Farmers-open-outlet-to-sell-organic-farm-produce/articleshow/52547553.cms). Their products include millets, local rice varieties, and pulses, which are now available in Chhattisgarh, with marketing arrangements being made to sell these to urban markets. The FPO showcased their branded and packaged products at the TRFA-NFSM workshop held in Raipur on 8 September 2018.

4.2.4 Private sector initiatives on sustainable VCI – building high-value agriculture

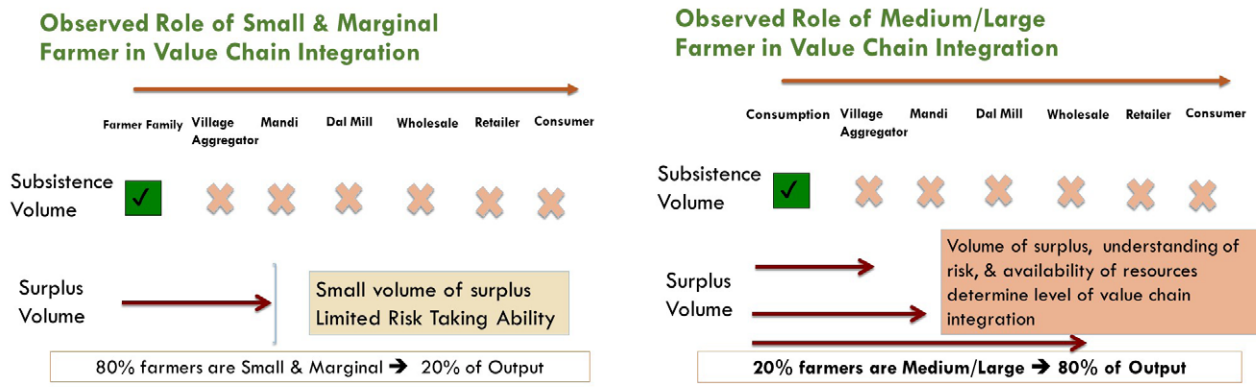
Irrigated parts of the Chhattisgarh plains area are being tested for production of hybrid seeds of rice, maize and vegetables. Companies like VNR Seeds (near Raipur) are producing hybrid F&V seeds for sale in the state and also outside the state. The company is actively supporting a network of progressive farmers under the banner of Chhattisgarh Yuva Pragatisheel Kisan Sangh, located in Durg. Farmers in this network cultivate horticultural and other high-value crops in over 25,000 acres of land across the state. Indo-American Hybrid Seed Pvt. Ltd, headquartered in Hyderabad, has been producing hybrid rice seeds in the state for the past four years. Multinational seed companies are also working towards developing alternate hybrid seed production locations beyond Andhra Pradesh and Telangana, and Chhattisgarh is one such location where they are piloting hybrid paddy seed production.

These high-value interventions in precision farming, both horticulture crops and hybrid seed production, augur well for the future of farming in the state of Chhattisgarh. Many CSOs are working closely with the district administration in aspirational districts to create FPOs for local produce, such as dals, rice, millets, etc.

4.3 Summary of field observations – understanding farmer behaviour in VCI

Typical value chain analysis focuses on efficiency and productivity gains through identification and removal of bottlenecks/constraints. This is a static approach that overlooks the feedback loops that are present in the system – for example, the impact of price volatility on producer behaviour, the availability of targeted benefits/subsidies to select players in the value chain. Producers tend to minimize risk-taking behaviour. During the field visits to Odisha and Chhattisgarh, discussions were held with stakeholders across the value chain, including with farmers with different land holdings - small and marginal farmers as well as

Figure 30 (a and b)
Observed roles of the two groups of farmers in value chain integration



medium and large farmers, who were both part of the TRFA scheme implementation and were also farming non-TRFA crops.

Figure 30 (a and b) above presents observed VCI activities of the two groups of farmers – small and marginal farmers, who represent 80 percent of the total number of famers, and the remaining 20 percent of farmers who are medium and large landowners. Given the land holding patterns observed in these two farmer groups, the volume of production is inversely related to the number of farmers in each group. Hence, the medium and large farmers, while being small in number, contribute up to 80 percent of the total production output. The premise of this schematic is that the TRFA programme will generate adequate surplus volume that is marketed by the producer; otherwise the production will be used primarily for self-consumption.

As stated in the observations in sections 4.1 & 4.2 above, the small and marginal farmers were limited to mostly self-consumption (see green boxes in figures above) as the production volume was not adequate for marketing. Wherever there was a marketable surplus, they sold the same (or in some cases bartered it) to village-level aggregators, who, in most cases, were large farmers (see extent of red arrow in top half of the figure).

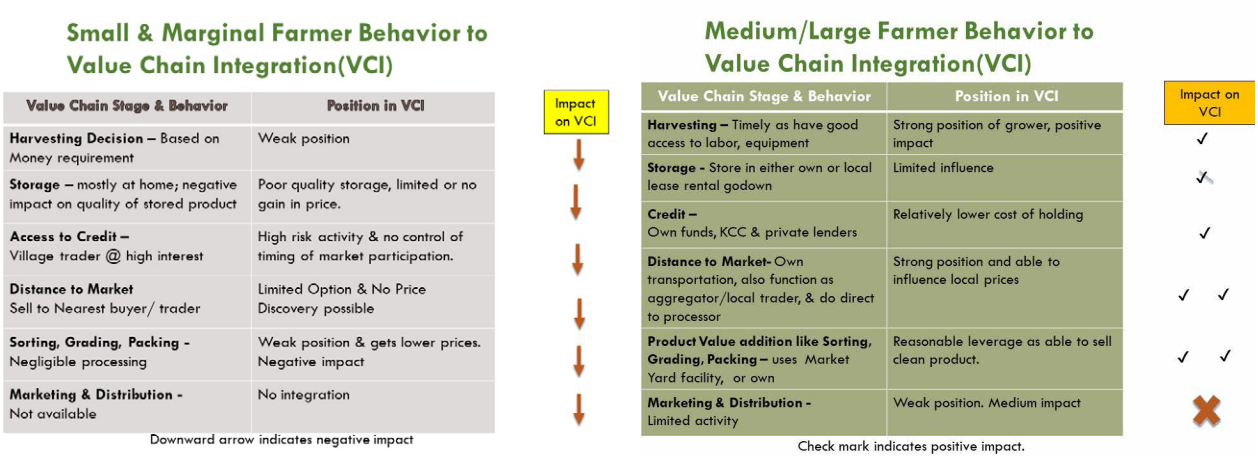
For the medium and large farmers in TRFA, the situation was very different (figure 30b above). Production was bifurcated for self-consumption (and seeds, where necessary) and marketing. The nature of VCI for these farmers was a function of: the surplus volume produced, access to finance and storage, and the motivation to participate in value chain activities. This is shown in the bottom half of the figure above.

Continuing with the categorization of farmers into two groups viz. - small and marginal, and medium and large farmers, distinctive responses were observed from the farmer groups on various aspects of VCI activities. The behaviour of farmer groups at each stage of the value chain, along with the impact of their actions (behaviour) on VCI is depicted in Figure 31 (a and b). It is important to note that this schematic will be relevant for a wide range of agriculture crops and also for horticultural produce.

Figure 31 (a and b) describes the different value chain activities, such as harvesting and storage, access to credit, access to market or distance to nearest market, access to sorting/grading equipment, etc. The responses given by the two farmer groups are distinctly different, and these actions have a direct bearing on the level of VCI for these farmers. For example, a small farmer who has a surplus crop is known to sell it immediately, as his requirement for finance is high. Small farmers have very low volumes, and this hampers their bargaining power in the market, according to the International Fund for Agriculture Development (IFAD, 2017). However, large farmers will prefer to store the same and wait for better market prices during the off-season.

The problems across the critical points of value chain activities reflect the fact that the small and marginal producer has limited or no access to credit, to services around aggregation and quality control, to visibility of market prices and timing to harvest. Higher-order value chain activities like branding and marketing of packaged produce are far from the day-to-day realm of the small and marginal producer. Poor producers have fewer

Figure 31 (a and b)
Observed behaviour of the two groups of farmers in value chain integration



Small & Marginal Farmer Behavior to Value Chain Integration(VCI)

Value Chain Stage & Behavior	Position in VCI	Impact on VCI
Harvesting Decision – Based on Money requirement	Weak position	↓
Storage – mostly at home; negative impact on quality of stored product	Poor quality storage, limited or no gain in price.	↓
Access to Credit – Village trader @ high interest	High risk activity & no control of timing of market participation.	↓
Distance to Market Sell to Nearest buyer/ trader	Limited Option & No Price Discovery possible	↓
Sorting, Grading, Packing - Negligible processing	Weak position & gets lower prices. Negative impact	↓
Marketing & Distribution - Not available	No integration	↓

Downward arrow indicates negative impact

Medium/Large Farmer Behavior to Value Chain Integration(VCI)

Value Chain Stage & Behavior	Position in VCI	Impact on VCI
Harvesting – Timely as have good access to labor, equipment	Strong position of grower, positive impact	✓
Storage - Store in either own or local lease rental godown	Limited influence	✓
Credit – Own funds, KCC & private lenders	Relatively lower cost of holding	✓
Distance to Market- Own transportation, also function as aggregator/local trader, & do direct to processor	Strong position and able to influence local prices	✓ ✓
Product Value addition like Sorting, Grading, Packing – uses Market Yard facility, or own	Reasonable leverage as able to sell clean product.	✓ ✓
Marketing & Distribution - Limited activity	Weak position. Medium impact	✗

Check mark indicates positive impact.

options available and therefore tend to have low risk appetites. According to IFAD, "Risk avoidance strategies thus have higher opportunity costs: some studies estimate that average farmer incomes could be 10 to 20 percent higher in the absence of risk." (2011)

Production of pulses and oilseeds during rabi in rice fallows is akin to precision farming. Timely availability of inputs, knowledge of residual moisture, and coordinated action of different service providers are all essential to deliver both quantity and quality of crop. During field visits, it was observed that these inputs were available to mostly medium and large farmers. Conversely, the absence of these inputs for small and marginal farmers has a significant negative impact on their financial and psychological well-being. Further, challenges linked to climate change and unseasonal weather patterns compound the problem for these growers.

The opportunities for the medium and large growers rest on their ability to access credit as well as easy availability of storage facilities for the harvest. These farmers are able to 'play' the market. Given that many of them also operate as village-level aggregators, they can potentially exert some level of price maker behaviour when dealing directly with processors.

Recommendations

Based on the findings of the field work, the study team presented draft recommendations on opportunities for fodder management and building VCI for surplus pulse and oilseed production that will emanate from the production programmes under the TRFA Scheme. The recommendations were presented at the NFSM Workshop on Strategizing Pulse Production in Rice Fallows in Eastern India, held on 8 September 2018 at Raipur, chaired by the Agriculture Commissioner, DAC&FW, GoI. The recommendations are further validated by the feedback received from the TRFA states and other stakeholders.

The section on recommendations is divided into two parts. Section 5.1 details the recommended approaches for addressing issues around open grazing and what could be done to support the TRFA farmers. Section 5.2 outlines the approaches that the state government can take to integrate TRFA farmers into value chains, both private and state-managed.

5.1 Recommendations on controlling open grazing

This section details feedback received from various TRFA states on the presentation of interim technical findings. It also presents options available to strengthen fodder management to manage stray cattle in the TRFA areas.

The preceding discussion revealed that it is not only stray cattle but a variety of issues that are affecting pulse cultivation in rice fallows. Therefore, any solution requires a combination of strategies that address research and development, policy, and institutional and technological issues in order to enhance and sustain pulse production for improving farmers' incomes.

5.1.1 Research and development issues

These are the research and development issues that need to be addressed:

Promotion of dual-purpose crops, such as sorghum, maize and multi-utility fodder trees: In rainfed areas, livestock plays an important role in enhancing farmers' incomes. Agriculture needs to complement the livestock sector by integrating fodder crops to improve fodder production. Dual-purpose crops such as sorghum (CSH 24MF, MP chari) cowpea, and maize (NK 6240, RCH 1) need to be promoted in upland areas where cultivation of kharif rice is practiced. The advantage of this system intensification would be increased fodder availability (sorghum – 3.5 tonnes/ha, Maize – 5 tonnes/ha, green cowpea – 0.8 tonnes/ha) without compromising the yield of the main crop. Planting leguminous fodder crops such as Lucerne (Alfalfa), berseem, *dasharath* and forage shrub (Leucaena) on the outer bunds of rice fields and multi-utility fodder trees are essential for ensuring fodder availability.

Fodder nutrient enrichment: Crop residues form the bulk of the basal diet of ruminants in India. Large quantities of straw (rice, wheat, finger millet) and stover (from maize and sorghum) available in India are of poor nutritive value. The quality of such straw needs to be improved for livestock to gain the benefit of a balanced ration and to supplement the major roughage requirement of Indian livestock. Crop residue can be enriched by ammonization, urea molasses mixture, and urea enrichment. Crop residues during kharif can be fortified with feed ingredients like cakes, bran, grains, molasses, hay, and minerals, and then densified into blocks or pellets to save on storage and transport costs. Thus, in rice fallows, farmers need to be encouraged to use available rice straw by improving its quality through interventions such as chopping and urea treatment.

Rice fallow areas are plagued by low soil moisture after the harvest of rice and by water scarcity. With scant knowledge on soil moisture availability and the cropping pattern to follow, many farmers leave such fields unattended. Those who do cultivate incur crop failure due to moisture stress and stray cattle. Identifying and mapping potential areas suitable for rabi crops can help in suggesting suitable crops to facilitate cluster-based community farming that involves sharing of resources that can enhance the economic efficiency of the individual farmer through increased fodder availability and cropping intensity. Community farming, promoted to cover larger areas, can aid in converging site-specific programmes.

5.1.2 Institutional issues

Local stakeholders need to be involved in land management initiatives. A perception has emerged that the management of these resources is the sole responsibility of the government. However, evidence suggests that though small in number and isolated, farmers themselves have ensured informal institutional involvement in effectively managing fodder resources and livestock population. Local institutional mechanisms such as *charwaha, gochar* (grazing land) and community fodder banks have been promoted to stimulate community involvement. Community-driven solutions need

to be strengthened in collaboration with local panchayat raj institutions:

Strengthening farmer-driven solutions to control stray cattle: The *charwaha* system of undertaking animal grazing collectively runs in Chhattisgarh from June to October/November and in Odisha from June to March. Odisha has a more streamlined charwaha arrangement compared to Chhattisgarh, where it is confined to only four or five months. To protect crops from stray cattle, prevent crop damage and effectively harvest a rabi season crop, there is a need to extend this arrangement up to March.

Encouraging block fencing through incentives: Resource-rich farmers in these regions are currently investing in individual field fencing to protect their crops from stray cattle and wild animals. However, small and marginal farmers cannot afford to do this, as the total cost of fencing an acre with wooden poles is approximately INR 60,000, an investment that lasts for five years. In some cases, farmers use cement or stone sliced poles with barbed wires. Hence, there is a need to identify cluster of fields suitable for rabi cultivation and promote block fencing through Farmer Interest Groups (FIGs) by converging financial and technical inputs from agriculture and panchayat raj departments.

Promoting bio-fencing as a sustainable and long-term solution: Currently, a few farmers have hedgerows with biodiesel plants and other trees along with barbed wire, which is cost-effective. The planting of field bunds with fodder trees such as *udhiyan*, Thespesia, *kodukkapuli* can be promoted; these can be planted in 4-5 m intervals. The gap between these trees can be filled with small trees like *Supabul* and *Gliricidia* to control the entry of stray animals. These trees should be pruned at 1.5 m height to generate new lateral branches, and can be used as feed for animals. Bio-fences should be able to yield three or four tonnes of fodder annually, prevent soil erosion, and protect soil moisture. Grasses like *kolukkattaipul*, guinea grass, etc. can grow on bunds that are 1-2 feet high. *Gliricidia* is an excellent option, as it additionally helps in enriching soil fertility by producing 500 to 1000 kg of green manure.

Installing solar power fencing systems: Solar fencing is a viable option to protect crops from wild animals and can be promoted with proper incentive mechanisms. The GoI and several state governments are offering subsidies for erecting solar fencing. For example, the Government of Goa is offering a subsidy for a maximum length of 2000 running meters per farmer. The subsidy is restricted to 90 percent of the admissible cost of INR 2 lakh for individuals and INR 30 lakh for farming groups. Similarly, the Government of Telangana is offering a 50 percent subsidy for a maximum length of 1000 meters at the rate of INR 201 per meter. However, feasibility studies need to be conducted by state governments to examine the cost and benefits of solar fencing. Further, there is a need to establish pilot demonstration units at a few locations to find out the effectiveness and utility of solar-powered fencing systems for crop protection and measures to replicate them; accordingly, a subsidy mechanism can be worked out.

Appointing *rakshaks*/scouts: One of the suggestions under TRFA was to engage two rakshaks/scouts for four months in each village in order to protect crops from stray animals (and also to conduct awareness campaign to sensitize the farmers to the necessity of paying a minimum wage). As there are no clear guidelines for reporting and escalations, either the sarpanch or the village agriculture worker would monitor the functioning of these rakshaks/scouts. Currently, farmers feel that the number of *rakshaks*/scouts is inadequate to address the problem arising from wild animals and stray cattle.

Strengthening existing department fodder farms for production of foundation and certified seeds: Various initiatives have been undertaken by multifarious agencies (public, private, NGOs etc.) for promoting green fodder production and distributing fodder seeds/root slips at the institutional and farmer levels. These agencies are also involved in setting up fodder seed production farms and fodder nurseries to support the production and availability of improved fodder varieties. These farms also serve as demonstration and training units for fodder production and promotion. However, there is a need to strengthen the existing departments to help them focus on promoting community fodder production through integrated and participatory research and extension approaches. Since native species have a higher chance of surviving under natural conditions, especially in grasslands, at least one such germplasm bank with associated nursery network may be set up in each state.

5.1.3 Technological issues

Training, demonstration and field visits must be conducted regularly by field staff and other stakeholders to update their knowledge and to disseminate the same to the farming community. Programmes can even focus on effective fodder

utilization practices like silage-making, dry fodder enrichment etc. Suitable models to integrate fodder species into intensive agricultural practices need to be developed using GIS mapping/remote sensing in collaboration with research institutes or universities, to be promoted widely.

Pulse cultivation in rice fallows can be enhanced through the promotion of holistic crop management strategies that focus on seed treatment and priming, mechanization (zero tillage, relay cropping, mulching, etc.), critical irrigation, and micronutrient application. This can substantially improve the survival and performance of pulses in rice-fallows.

Another issue that needs attention is the timely availability of quality seed materials. This can be done by developing a local seed production system of suitable varieties and setting up a seed chain. Seed production must be linked with national and state seed corporations to meet quality parameters.

5.1.4 Policy issues

One of the critical constraints for rice fallow cultivation is the lack of mechanization. There is a need for introducing need-based, low-cost mechanization to ensure proper germination of seeds and, later, seedling establishment, besides reducing the drudgery and increase the efficiency of labour. Mechanization can be useful to take up more land area, which can be made possible through land consolidation. However, in undulated lands in hilly terrain and in small holdings of marginal and small farmers, there is a need for small equipment which can operate under local conditions and still increase efficiency. These reduce drudgery and increase the ease of handling inputs and their application to the crops.

Rehabilitation of common lands through community participation and convergence of programmes is important in order to regulate grazing and to protect various ecosystem services. This calls for mapping ecologically sensitive pasture lands and developing them through convergence of different ongoing schemes/programmes in their respective states. Management of common grazing lands must improve in order to enhance their productivity. Encroachments on such lands must be removed by promoting users' associations and through the participation of panchayat raj institutions and civil society organizations. If needed, these institutions can be assisted through financial, technical and legal backstopping. Farmers must be motivated to strengthen their scientific knowledge.

Most pastures are neither defined nor marked on the ground. These non-designated grazing lands are gradually being put to other uses, causing a reduction in the already fragmented grazing lands. Invasive plant species such as lantana and parthenium can invade grazing lands, severely affecting their productivity. Such species must be replaced with native fodder species.

A proper landscape management plan at the village/gram panchayat level can be prepared by line department staff with community participation to identify suitable lands for fodder production. This needs to be converged with ongoing development programmes such as MGNREGA, Joint Forest Management (JFM), watershed development, wasteland development, etc. There should be a focused programme of rehabilitation/rejuvenation and promotion of silvopasture on revenue and wasteland, which will not only meet the shortage of feed and fodder but also offer equal access to poor farmers and improve the environment. Similarly, fodder blocks need to be developed in forest fringe villages through revival and development of pastures on CPRs in collaboration with gram panchayats.

A convergence of different line departments will provide holistic solutions to the central problem. Open grazing lands at the panchayat level should be earmarked, and degraded and encroached grazing lands should be rejuvenated by converging state and centrally sponsored programmes.

5.2 Value chain integration

This section details possible approaches to achieve VCI of farmers operating in the TRFA scheme to market opportunities.

The focus of the recommendations is on small and marginal farmers, as they are the most disenfranchised group in any production system. (Refer to summary of field observations in section 4.3.) Given that TRFA requires working on marginal lands, it is imperative that value chain actors are made an integral part of the TRFA programme design. In the face of multiple risks it is essential to consider the resilience of the primary producers, agribusiness entities, institutions and other supply chain stakeholders for ensuring collective action, coordination and public-private cooperation. Periodic engagement with value chain actors using different tools like mobile messaging, trade meetings, field days, APMC posters, etc. has

the potential to reduce information asymmetry and its impact on the production and availability of marketable surplus.

The recommendations on VCI are very specific to the needs of small and marginal farmers. The focus is on the role of the state in the creation of public good institutional arrangements using existing budgetary allocations without creating an additional burden on the exchequer. These recommendations are structural in nature and are by no means exhaustive. One example of emerging private sector (Tata iShakti) innovations in building pro-poor VCI demonstrates the need for real integration of all stakeholders, starting from design of the scheme. It is hoped that the series of steps, once implemented by the state government, would incentivize value chain actors to participate more vigorously in the VCI activities under the TRFA programme.

Feedback from TRFA states on findings

The set of findings and draft recommendations were shared with each of the 6 TRFA states for obtaining their inputs. Given below are specific inputs/comments received from the states. These have been incorporated in the final recommendations.

- Need to bring appropriate infrastructure at village level as part of the programme
- Up gradation of Market Committee infrastructure pulses handling (post-harvest process) required to ensure a level playing field
- Take learnings from other models like custom hire centers (CHC), farming-as-a-service (FAS) & experiences of non-TRFA states to hasten value chain integration in TRFA.
- Extend new institutional arrangements like FPO, Livelihood Value Chains, etc. to the TRFA scheme in order to better utilize the funds being allocated.

5.3 Options for VCI

The success of any VCI activity requires a systemic approach deployed over a long-term horizon supported by appropriate feedback loops. Both the yield and price risks are higher for pulse production compared to cereal production (Byerlee and White, 2000). The risk is mainly due to the conditions in which pulses are grown – in general, pulses are grown in marginal areas and under largely rainfed conditions (Joshi and Birthal, 2002)

State-level policy actions are the prime initiator of any public good-driven VCI, more so in the context of production being undertaken in marginal areas. This step is fundamental to influence private outlay of capital on public good-driven value chains. Policy action should ensure that interventions are seen as time-specific with a focus on outcomes. The design of the intervention should include measurable outcomes.

Within the existing framework of government schemes, there are three options to VCI. The entry points for approach are described below, along with examples from current programmes that are under implementation either by both the central government and state government or by the state government only.

Option 1

Option 1 is to leverage existing programmes/ schemes that are operational within the Ministry of Agriculture. For example, there is opportunity to build on the existing programmatic approach of the TRFA Scheme Guidelines to integrate with programmes of the other departments of the Ministry of Agriculture, such as Agriculture Marketing, etc. This approach allows for better utilization of budgets in a targeted area, thereby increasing the possibility of greater impact.

The paragraphs below describe two examples of possible integration. In the first case, VCI takes place for pulses produced under NFSM through the SFAC (a part of the Ministry of Agriculture) under a National Demonstration Project (NDP). In the second case, there are existing schemes, namely Sub-mission on agricultural mechanization (SMAM) and Rashtriya Krishi Vikas Yojana – Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR), of the Ministry of Agriculture, that could be used to provide support to TRFA implementation activities.

National Demonstration Project within the MoAC&FW

SFAC is managing over a hundred FPO on pilot basis under the NFSM programme. The NDP has a three-year mandate to form and operate FPOs. The NDP is currently executing 17 FPOs on pulses under the NFSM and over 100 FPOs under the MIDH(Mission on Integrated Development of Horticulture).It is expected that during 2019-20, the NDP will have a mandate to create FPOs under the NMOOP for oilseeds. The FPOs, under the

guidance of SFAC, will provide a wide range of VCI activities.

List of activities being undertaken under NDP–FPO Formation:

- Three-year engagement - year 1 formation and years 2 and 3 hand-holding
- Infrastructure support under NFSM – Mini dal mills, procurement centres
- Input services – supply of quality planting material, inputs, soil testing at reduced cost
- Access to credit
- Equity grant up to INR 10 lakhs
- Credit guarantee fund
- Marketing established linkages with aggregator, retailers and processors
- State procurement centres
- Branding and packing
- Skilling and training – training of CEO and board of directors at institutes like National Institute of Agricultural Marketing (NIAM), Jaipur
- Provision for each state government to integrate the state-promoted pulses FPO into the NDP being managed by SFAC

The budgetary provision for TRFA integration will come from the state's agri-marketing outlays and the equipment budget will be from the scheme on agriculture mechanization, from the community and usage charges from producers, traders, etc.

Integrate with other schemes of MoAC&FW

The department has two very specific schemes that provide financing for VCI for small holder farmers. Elements of these schemes should be bundled with the TRFA programme to ensure that appropriate on-ground infrastructure is created for VCI of TRFA pulses.

SMAM is a mission under the Ministry of Agriculture and Farmers Welfare (MOAFW) that aims to increase the reach of farm mechanization to small and marginal farmers in regions where farm power is low. This is achieved through promoting custom hiring centres and creating hubs for hi-tech and high-value farm equipment. The scheme provides 50 percent to 80 percent subsidies to farmers on purchase of farm machinery and equipment, with higher levels of subsidies available for scheduled tribes (ST) and scheduled caste (SC) groups and for women. The scheme provides subsidies for equipment for both production and post-harvest processing. (See Box 1 on the benefit-cost analysis of mini dal mills.) (Source: AED, ICAR).

RKVY-RAFTAAR is a three-year scheme, from 2017-18 to 2019-20, with a financial allocation of INR 15,722 crore, and with broad objectives of making farming a remunerative economic activity through strengthening the farmer's effort and risk mitigation and by promoting agri-business entrepreneurship. Under RKVY-RAFTAAR, the major focus is on pre- and post-harvest infrastructure, besides promoting agri-entrepreneurship and innovations.

BOX 1: BENEFIT-COST ANALYSIS FOR MINI DHAL MILL

Assumptions
Capacity of dal mill unit: 10 tonnes/month (25 days/ month) (75 % of the rated capacity; 13.5 tonnes/month)

Recovery: 70 %
Monthly repair and maintenance charges: 1 % of the cost of machines.

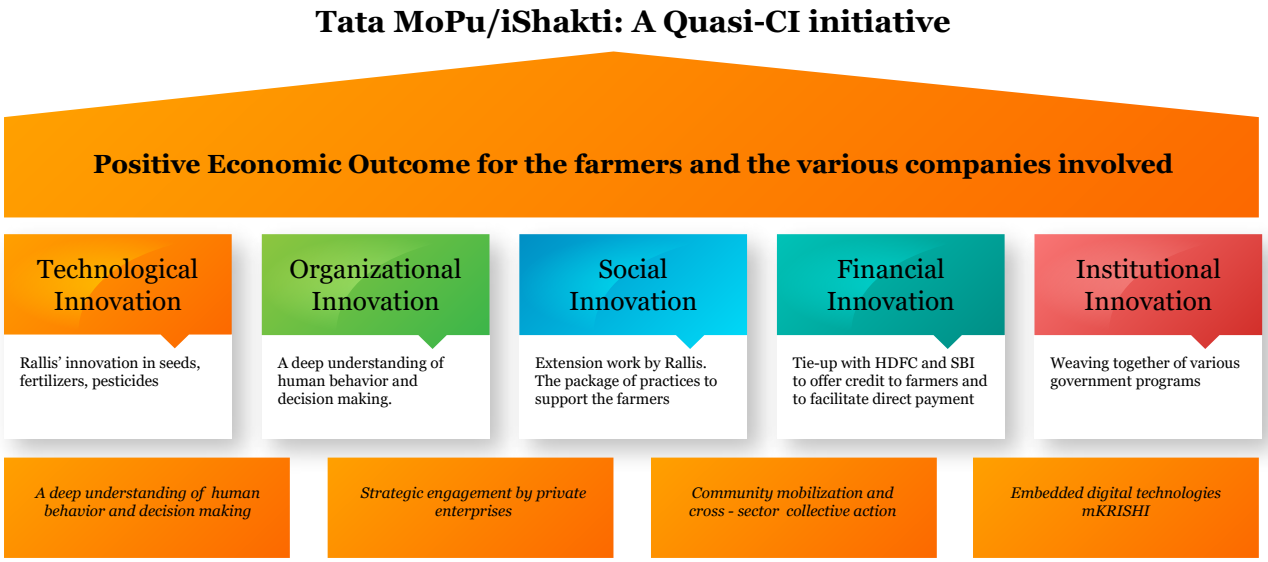
Depreciation on machines and equipment: 10 % p.a.;Depreciation on furniture and tools: 20 % p.a.

Rate of interest: 11% p.a.
No. of working days in a month: 25; Total number of working days in year: 300; Working hours per day: 8

Capacity utilization: 1st year 50%; 2nd year 60%; 3rd year 70%; 4th year 80 %; 5th & subsequent years 90%.

Fixed Capital		
Land & building		
Land 200 m2 @ Rs. 50 / m2		Rs. 1,00,000-00
Building 100 m2 @ Rs. 500 / m2		Rs. 50,000-00
Plant and Machinery		
Dal mill, sieves, cleaners, elevators etc.		Rs. 1,25,000-00
Electrification & Installation charges		Rs. 25,000-00
Furniture		Rs. 5000-00
Total		**Rs. 3,05,000-00**
Working Capital (per month)		
Staff and Labour		
Skilled		Rs. 2,500-00
Un-skilled		Rs. 1,500-00
Raw material		
Pulses (10 tonnes/months) @ Rs. 17,500/tonne		Rs. 1,75,000-00
Edible oil, 20 kg @ Rs. 50/ kg		Rs. 1,000-00
Gunny bags		Rs. 2,500-00
Utilities		Rs. 3,05,000-00
Electricity 300 units @ Rs. 4.50		Rs. 1,350-00
Other expenses		
Consumables		Rs. 250-00
Telephone		Rs. 500-00
Repair and maintenance (1 % of cost of machines)		Rs. 1,500-00
Transport charges		Rs. 1,000-00
Total working capital (per month)		Rs. 1,87,100-00
Working capital for 1.5 months = 1,87,100 x 1.5 = Rs. 2,80,650		
Total Capital Investment		
Fixed Capital		Rs. 3,05,000-00
Working capital for 1.5 months		Rs 2,80,650-00
Total		**Rs. 5,85,650-00**
Annual Cost		
Total working capital		Rs. 22,45,200-00
Depreciation on machines		Rs. 12,500-00
Depreciation on furniture		Rs. 1,000-00
Interest on Total Capital Investment @11%		Rs. 64,422-00
Total		**Rs. 23,23,122-00**
Profitability		
Annual Profit = Rs. 25,08,000 – Rs. 23,23,122 = Rs. 1,84,878	**Profit on sales (%) = 7.37 %**	**Return on capital investment = 31.57 %**
Break-Even Point		
Fixed Cost		
Interest on Total Capital Investment		Rs. 64,422-00
Depreciation		Rs. 13,500-00
40% of annual wage		Rs. 19,200-00
40 % of overheads (incl. utility)		Rs. 22,080-00
Total		**Rs. 1,19,202-00**
Break Even Point = 1,19,202 / (1,19,202+1,84,878) x 100= 39.20 % **Pay-back period = Total cost of project / profit = 305000 / 184878 = 1.65 years**		

Figure 32
Tata MoPu/iShakti – a Quasai Convergent Innovation Model



Source: *Srivardhini, IFPRI 2014*

Option 2

This recommendation builds on the base of Option 1 by going beyond the schemes/programmes of the Ministry of Agriculture. Under this option, it is proposed that the TRFA programme integrates with the rural livelihoods and value chains programme of the NRLM under the Ministry of Rural Development.

Deendayal Antaya Yojana (DAY) - NRLM, also known as DAY-NRLM, is operating in different states to implement the development of farm-based value chains to enhance local enterprise and employment opportunities. The development of the farm-based value chains should lead to: a) engaging rural youth in farm enterprise; and b) deep engagement of women's SHGs in enterprise development. These will be done through: (i) enhanced access to credit in the value chain, starting with small producers through revolving funds; and (ii) technical and convergent support for the member households to diversify their livelihood assets.

The programme uses several tested tools in partnership with UN agencies, domain experts and civil society organizations. These tools include:

- Development of partnerships for the building of market linkages and value addition activities
- Development of intervention strategy, business plan and execution plans for VCI
- Promoting suitable institutional architecture for community-based organizations for VCI
- Bankable value chain financing models for producers' organizations
- Capacity building for the project staff and community members on farm livelihoods and value chain development

The Farm-Based Value Chain programme of NRLM has the potential to be an excellent platform to engage the TRFA villages on VCI. This programme, with a special emphasis on rural youth and women members of SHGs, will offer a high degree of resilience and create a local virtual loop for off-take of the surplus product that will be generated via the TRFA production-related activities. This programme is being implemented by the respective SRLM in the states of Odisha and Chhattisgarh, and will be expanded to other NRLM states selectively.

In the private sector, Tata's iShakti brand and its supply chain development is an early example of the private sector taking the lead in using convergence tools in the building of pro-poor value chains. Convergent innovation (CI) (Srivardhini, IFPRI 2014) is the integration of technological, organizational, social, financial and institutional innovation by multiple actors to achieve inclusive and sustainable economic growth and human development. It is a form of meta-innovation – an innovation in the way we innovate – that is built on four core tenets:

- A deep and actionable understanding of

human behaviour and decision-making
- Strategic engagement by private enterprises
- Community collaboration and multi-sector collective action
- Embedded digital technologies

Option 3

This route proposes an approach that requires transformation of the TRFA programme to a mission-mode programme, wherein all VCI activities are within the TRFA programme. The past experience of the GOI and, in particular, the Ministry of Agriculture indicates that large-scale transformation, e.g. NFSM, can be achieved through a 'mission mode.' TRFA is indeed a transformational programme, and a similar approach would be the recommended strategy for implementation.

There are several examples of GoI programmes that have delivered time-bound results when operated on "mission mode". The NFSM is one such example. The key ingredient of mission mode functioning is coordinated and timely action by all stakeholders. All the budgets for the mission activities are kept within the mission. This includes activities related to production, value chain development and integration. The example below is from Odisha, where the state government designed a mission mode approach to enhance the production and consumption of millets by tribal communities of the state. The Odisha government launched Mission on Millet in 2016-17. This programme is being managed under the state's Planning Department in "mission mode". The programme incorporates all elements of society, including the private sector, CSOs, producers, research institutions, government departments, and innovators.

The programme is designed to deliver benefits across a wide range of outcomes over a five-year time horizon. These outcomes are:

- Increasing household consumption of millets by about 25 percent to enhance household nutrition security and to create demand for millets with a focus on women and children
- Promoting millet processing enterprises at the panchayat and block level to ease processing for households and for value-added markets
- Improving productivity of millets crop systems and making them profitable
- Developing millets enterprises and establishing market linkages to rural/urban markets with a focus on women entrepreneurs
- Inclusion of millets in state nutrition programmes such as Integrated Child Development Services (ICDS), Mid-Day Meal (MDM), and Integrated Tribal Development Agency (ITDA) welfare hostels, and eventually in the PDS
- Increased production to at least 1.20 lakh quintals
- Introduction of millets in ITDA Hostels, ICDS and MDM, and inclusion of millets into the PDS
- Increased household consumption by 25 percent and promotion of improved agronomic practices in 30,000 ha
- Establishing 120 functional seed centres managed by farmers
- 400 millet-based enterprises in the 30 blocks of the identified districts.
- 30 FPOs will be established in all the 30 blocks
- Transformation of the programme blocks in to organic millet hubs

Odisha's Mission on Millets is now being promoted as the benchmark for creating a multidimensional programme with sustained long-term outcomes. Recently, Dr. Ashok Dalwai, Chairman, Committee on Doubling of Farmers' Income, commended the Odisha State government on the programme, and asked other states to look at Odisha's model for increasing the production and consumption of nutri-cereals (millets, etc.).

VCI is a very complex activity that needs careful design and participation of all stakeholders. A single approach is unlikely to address the needs of all stakeholders. However, it is clear that building value chains for small and marginal farmers must start with the policy tools available to the state. The decision to deploy a particular approach is a function of several factors, some of which include budgetary allocations, convergence culture of the different line departments in the state, and cross-skilling capacities of field staff. The state will need to build appropriate feedback mechanisms to ensure that timely corrective steps are taken for the long-term success of the project.


MSSRF
ASHA
WASSAN
ଓଡ଼ିଶା ସରକାର
ସତ୍ୟମେବ ଜୟତେ
ओडिशा शासन
NCDS
CIVIL SOCIETY
ACADEMIA

Areas for future study

The current exploratory studies have attempted to cover extensive ground while working with severe constraints of data, time and scheduling field consultations. While these challenges will remain for any future work in this direction, it may be useful to consider doing a deeper analysis in the following areas:

- In the event of increasing fodder scarcity, it is essential to establish a value chain for fodder and milk. This will enable the bringing of available degraded land, pasture land and rice fallows exclusively under fodder crops or multi-purpose fodder crop cultivation.
- Suitable models aimed towards integration of fodder species or utilization of crop residues with intensive agricultural practices need to be studied using GIS mapping/remote sensing in collaboration with research institutes or universities. These studies also need to focus on the region-specific or agro-climatic zone-specific fodder or grasslands for the farming community.
- Rice fallow areas need to be mapped based on soil moisture availability, using GIS and remote sensing tools to promote site-specific crop planning and promoting cluster-based community farming to address social issues such as stray cattle.
- Shrinking landholdings and increasing labour scarcity can benefit from experiences in community farming. An in-depth study focused on its adoptability and scalability will go a long way towards building sustainable production systems in fragile areas such as rice fallows.
- A monitoring and evaluation (M&E) framework for the deployment of TRFA scheme is necessary. There is already an established template within NFSM to for programme reviews, and this could be extended to the TRFA scheme as well.
- A special focus is required on small and marginal farmers – there was no data available on the engagement of small and marginal farmers within the context of the outreach of the TRFA scheme. Based on our understanding of value chain behaviour of different types of producers, it is the small and marginal farmer who is the biggest loser in the race for building VCI. A study that looks into the outreach and outcomes for small and marginal farmers will go a long way towards building appropriate tools for integrating their surplus production into the value chains.
- Governments, both at the centre and the states, are spending significant amounts on building productive capacity of the growers, nutrition programmes and in capacity of rural youth and women for employment and entrepreneurship. There is little or no need to devote additional funds to building VCI. Instead, there is a need to bring together stakeholders and existing budgets across different line departments to come together on a common platform, so that an end-to-end solution can be devised and funded over an extended period of time. The core theme of convergence needs to be explored in greater detail to enable better design and implementation for the purpose of VCI.
- Several market facing institutions are working towards increasing Value Chain Integration. NCDEX is one such platform that is actively working to register FPO on the exchange (https://www.ncdex.com/index.aspx). They have on board 162 FPOs across 12 states, covering over two lakh farmers. A partnership with NCDEX could allow the TRFA programme to leverage the capabilities and experience of a very powerful market-facing institution, which in turn would hasten the VCI objective of TRFA.
- Valuable lessons from e-NAM should be incorporated – the e-marketplace initiative of DAC&FW has already converted over 580 mandis to electronic trading places. A critical step in electronic trading is a common and agreed understanding of quality parameters and assessment of the quality of produce being traded. Nagarjuna Fertilizers Ltd. is managing the quality assaying processes and related training programmes under a public-private partnership (PPP) model. Given that TRFA has a village-centric focus, it may be useful to evaluate if a similar arrangement with suitable design modifications can be institutionalized at the village level.
- Availability of risk transfer tools like insurance should be explored to encourage greater participation of value chain actors in the TRFA programme.

Conclusion

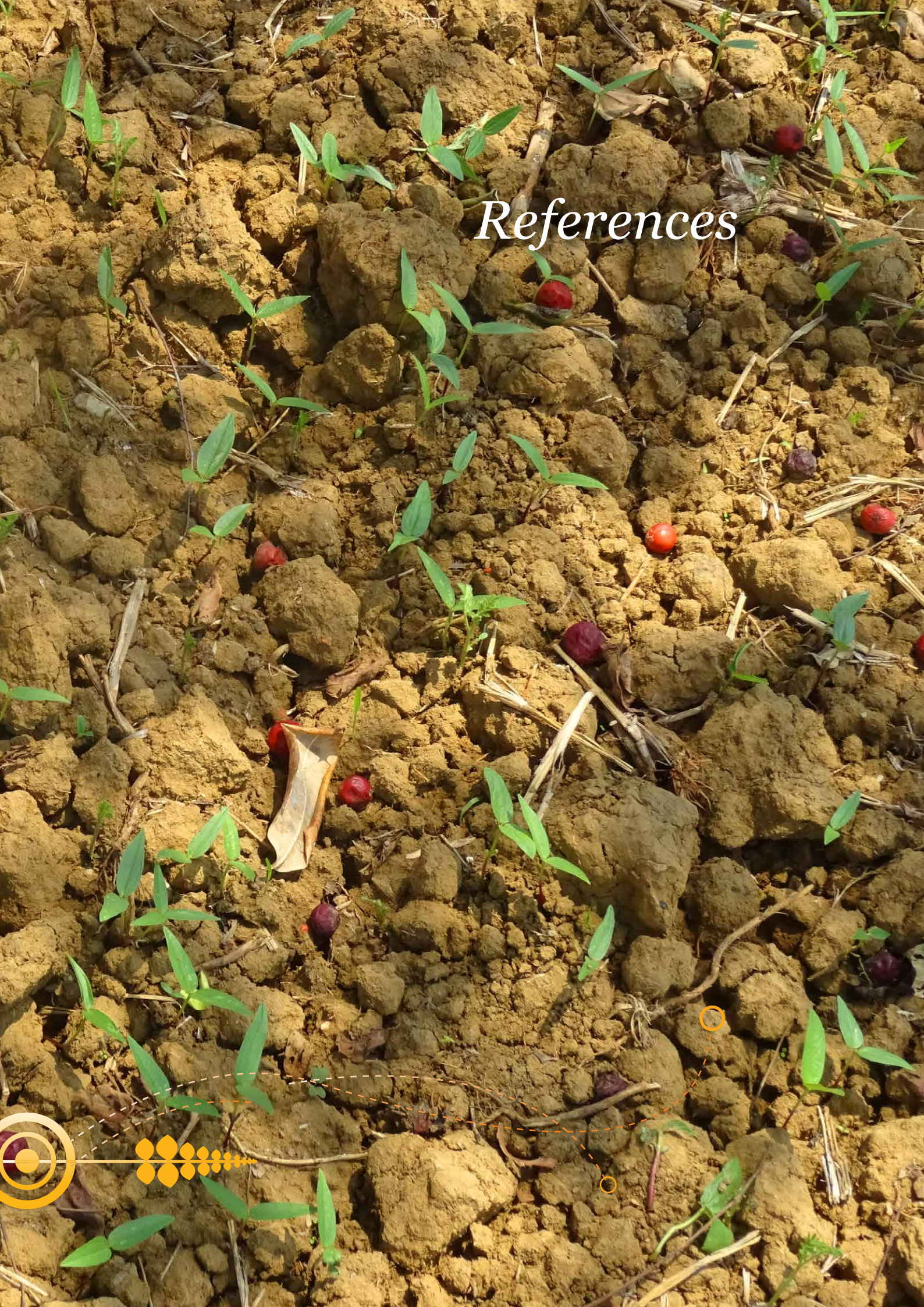
India accounts for 79 percent of South Asia's total rice fallows, which play an important role in its rural economy in terms of the huge scope to enhance pulse production. The productive utilization of these areas can overcome problems like food security, unemployment, migration and low incomes. However, the effective utilization of rice fallows is constrained by the lack of irrigation facilities, soil moisture stress at planting, water-logging, and excessive moisture in low-lying areas, as well as problems such as stray cattle and wild animals. Simultaneously, poorly developed value chains discourage farmers from taking up large-scale pulse production in rice fallows. Open grazing and a poorly developed value chain system are the most critical challenges hindering sustainable pulse production.

With deteriorating community grazing lands and reductions in land area due to encroachment, livestock resources are turning from assets to liabilities and endangering the very existence of croplands. Restoring and rejuvenating community grazing lands and their proper management are key to providing adequate forage/fodder and grazing to livestock and for protecting crops by restricting the movement of stray cattle. The community has to be encouraged to develop and manage such common grazing lands by forming user groups with appropriate incentive mechanisms.

For productive utilization of rice fallows, a holistic farming system is essential, where livestock needs are addressed along with food crops. Agriculture needs to complement the livestock sector by integrating fodder crops. Thus, dual-purpose cereal and legume crops need to be promoted in upland areas where cultivation of kharif rice is practiced. The advantage of this system intensification would be increased fodder availability without compromising the yield of the main crop.

Given the land holding patterns observed in the study regions, the volume of production is inversely related to the number of farmers in each group. Hence, the medium and large farmers, while being small in number, contributed 80 percent of the total production output, while small and marginal farmers contributed only 20 percent. Coordinated and timely action are required to leverage the existing system and related infrastructure of PACS and RMCs to procure surplus pulses that would be produced from the TRFA scheme. Local institutions need to be nurtured in order for any meaningful value chains to emerge. Further, sustained availability of surplus produce at the farm gate is essential to encourage transactions beyond the kharif season. There needs to be appropriate policy action to ensure convergence of agriculture and marketing.

The problems across the critical points of value chain activities reflect the fact that the small and marginal producer has limited or no access to credit, to services around aggregation and quality control, to visibility of market prices and timing to harvest. Higher order value chain activities like branding and marketing of packaged produce are far from the day-to-day realm of the small and marginal producer. The opportunities for the medium and large producers rest on their ability to access credit and easy availability of storage facilities for the harvest. These farmers are able to "play" the market. Given that many of them also operate as village-level aggregators, they can potentially exert some level of price-maker behaviour when dealing directly with processors.



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ପୁନଃ ଫସଲରେ ଗୋଷ୍ଠୀ ପ୍ରଦର୍ଶନ କ୍ଷେତ୍ର
TARGETING RICE FALLOW AREA IN EASTERN INDIA
(TRFA - Pulses)
ରବି ୨୦୧୭ - ୧୮
କିସମ-
ହିତାଧିକାରୀ ସଂଖ୍ୟା-
ବ୍ଲକ୍ - ସତ୍ୟବାଦୀ
ଗ୍ରାମ -
ସୌଜନ୍ୟ - ଉପ କୃଷି ନିର୍ଦ୍ଦେଶକ ତଥା ପ୍ରକଳ୍ପ ନିର୍ଦ୍ଦେଶକ, ଆତ୍ମା (ଆର୍.କେ.ଭି.ୱାଇ.) ପୁରୀ ମଣ୍ଡଳ, ପୁରୀ

Annexures


ATMA କାର୍ଯ୍ୟକ୍ରମ
ଓଡିଶା ସରକାର
ଉଦ୍ୟାନ ବିଭାଗ
SURAVI
SWOSTI FARMERS VEGETABLE MULTIPURPOSE CO-OPERATIVE SOCIETY LTD.
Regd no:- 100/KPT/31-12-2008.
SFVMPCS
SURAVI
ସୁରଭି
S.F.V.M.P.C.S
THE SWOSTI FARMERS VEGETABLE MPCS LTD.
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Annexure 1: Unit cost of solar-powered fencing

Particulars	Unit	Quantity
Area to be protected	Acre	1
Fence length (perimeter)	Meter	300
Fence height above ground level	Meter	2.14 (7 ft)
Number of wire rows / strands	Number	7
Spacing between wire rows	Meter	0.30
Pole-to-pole distance	Meter	5
Total pole height (above+below)	**Meter**	**2.74 (8.5 ft) (Ground level 1.5 ft)**

Technical specifications for above model and its cost

Sl No.	Name of item	Specification	Quantity	Rate (INR)	Amount (INR)	Remarks
I	Fencing work					
A.	Electrical unit					
1	Energizer	Input voltage: 12V DC; Input current: 500MA; Output voltage: 6.0 KV - 10.0 KV; Pulse interval: 1.2 second; Pulse duration: 0.3 milli-second, Output energy: 2.5 joules	1	10000	10000	
2	Fence voltage alarm		1	1000	1000	
3	Solar PV module	72 Wp	1	5500	5500	
4	Battery	80 Ah	1	5500	5500	
5	Hooter	320 DB	1	500	500	
6	Lightning diverter	Copper	2	2500	5000	
7	Mounting box	Mild steel with powder coating	1	3000	3000	
8	Module mounting structure with pole	Mild steel with powder coating	1	1500	1500	
9	Cables and hardware	2-core copper flexible cable (Mtrs)	5	30	150	
B	Fence					
1	H.T. wire	ACSR Conductor wire, 2.59 mm (12 guage), TATA make or equivalent	2200	5.5	12100	Total perimeter for protection X no. of wire rows + 100 m extra

Sl No.	Name of item	Specification	Quantity	Rate (INR)	Amount (INR)	Remarks
2	Corner / end posts	MS with galvanised, 40x 40 sq.mm pipe, 8.5 feet with PP insulator riveting	8	640	5120	2 at gates + one per 50 meter at corners/end
3	Support posts	MS with galvanised, 25x 25 sq.mm pipe, 8.5 feet with PP insulator riveting	22	390	8580	2 each at corner/end post + 2 at each post at 10 m
4	Intermediate posts	MS with galvanised, 25x 25 sq.mm pipe, 8.5 feet with PP insulator riveting	60	390	23400	As per spacing
5	Support pole bolts	Mild steel	22	25	550	One for each support post
6	Corner pole/ end insulators	Poly propylene	56	7	392	No. of corner post and end post X number of wire rows
7	Intermediate pole insulators	Poly propylene	420	7	2940	No. of intermediate posts X number of wire rows
8	Corner pole hooks	SS	56	7	392	No. of corner post and end post X number of wire rows
9	Wire tighteners	MS	21	25	525	One each at 100 m fence length
10	Joint clamps	GI	21	7	147	One each at 100 m fence length
11	Double insulated cable single core	ACSR wire, 2.0mm Dia	50	25	1250	LS
12	Earth kits (galvanizing)	Copper	6	700	4200	One each at 50 m fence length
13	Warning sign boards	PVC	30	75	2250	One each at 10 m fence length
C	Gates					
1	4 ft wide gate 1 leaf		1	32350	32350	LS
D	Instruments / tools					
1	Digital multi-meter	Range up to -20000 KV	1	7500	7500	

Sl No.	Name of item	Specification	Quantity	Rate (INR)	Amount (INR)	Remarks
2	Xenon flash tube		1	3000	3000	
3	Neon tester		1	2500	2500	
4	Tool kit (wire tightener handle twisting tool, pliers, double ended spanner for joining clamp tightening		1	1000	1000	
Total fencing work					140346	
E	Transportation with transit insurance				7017	5% of above
II	Civil Work					
1	Excavation for poles :- Providing and laying cement concrete for Post (CuM)	0.162	14.58	150	2187	CuM x number of corner/end, intermediate and support posts
2	Providing and laying cement concrete for Post (CuM)		14.58	800	11664	
	Total civil work				13851	
	Grand total (I+II)				154197	
III	Installation and commissioning				7710	5% of above
	Total				161907	
	Cost per meter of fence length				540	

Annexure 2: Model 1: Economics of fencing one-acre area

	Area (Acre)	Crop	Production cost (Scale of finance -INR/acre)	Pre-development yield (Q/acre)	Post- development yield (normal yield - Q/acre)	Incremental yield	Rate	Increased income from area (INR)	Crop damage due to wild animals (%)
Gross Area 1:	2	Food grains	10000	9	15	6	1400	16800	
Gross Area 2:	0	Vegetables	60000	39	65	26	2000	0	

	Area (Acre)	Crop	Production cost (Scale of finance -INR/acre)	Pre-devel-opment yield (Q/ acre)	Post- de-velopment yield (normal yield - Q/ acre)	Incre-mental yield	Rate	In-creased income from area (INR)	Crop damage due to wild animals (%)
Gross Area 3:	0	Fruits	60000	27	45	18	3500	0	
								16800	40%
Minimum wage rate (INR/day) = 162									

S. No.	Particulars	Yr-1	Yr-2	Yr-3	Yr-4	Yr-5	Yr-6	Yr-7	Yr-8	Yr-9	Yr-10
A	Expenditure										
i	Fixed cost of fencing	161907									
ii	Operation & maintenance cost (2% of fixed cost)		3238	3238	3238	3238	3238	3238	3238	3238	3238
	Sub-total cost	161907	3238	3238	3238	3238	3238	3238	3238	3238	3238
B	Income estimates										
i	Incremental income with fencing	16800	16800	16800	16800	16800	16800	16800	16800	16800	16800
ii	**Saving in labour cost (45 man days/season X 2 seasons)**	**14580**	**14580**	**14580**	**14580**	**14580**	**14580**	**14580**	**14580**	**14580**	**14580**
	Net income + Savings in labour	-130527	28142	28142	28142	28142	28142	28142	28142	28142	28142
	Discounting factor	0.87	0.76	0.66	0.57	0.5	0.43	0.38	0.33	0.28	0.25
	Discounted costs	140789	2448	2129	1851	1610	1400	1217	1059	920	800
	Discounted income	-113502	21279	11046	9605	8353	7263	6316	5492	4776	4153
	Present Valu (PV) of costs	154224									
	PV of benefits	-35219									

Table 1a. Production of pulses and oilseeds in India from 2005-06 to 2017-18 (in million tonnes)

Crop	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18 (4th AE)
Pigeon pea	2.74	2.31	3.08	2.27	2.46	2.86	2.65	3.02	3.17	2.81	2.56	4.87	4.25
Chickpea	5.60	6.33	5.75	7.06	7.48	8.22	7.70	8.83	9.53	7.33	7.06	9.38	11.23
Black gram	1.25	1.44	1.46	1.17	1.24	1.76	1.77	1.95	1.70	1.96	1.95	2.83	3.56
Green gram	0.95	1.12	1.52	1.03	0.69	1.80	1.63	1.19	1.61	1.50	1.59	2.17	2.01
Lentil	0.95	0.91	0.81	0.95	1.03	0.94	1.06	1.13	1.02	1.04	0.98	1.22	1.61
Other kharif pulses	0.54	0.70	0.96	0.80	0.49	1.33	0.93	0.62	0.71	0.77	0.72	0.89	0.82
Other Rabi pulses	1.36	1.37	1.19	1.28	1.28	1.33	1.34	1.60	1.51	1.74	1.50	1.77	1.76
Total pulses	**13.38**	**14.20**	**14.76**	**14.57**	**14.66**	**18.24**	**17.09**	**18.34**	**19.25**	**17.15**	**16.35**	**23.13**	**25.23**

Table 2b. Production of oilseeds in India from 2005-06 to 2017-18 (in million tonnes)

Crop	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18 (4th AE)
Groundnut	8.0	4.9	9.2	7.2	5.4	8.3	7.0	4.7	9.7	7.4	6.7	7.5	9.2
Castor seed	1.0	0.8	1.1	1.2	1.0	1.4	2.3	2.0	1.7	1.9	1.8	1.4	1.6
Sesamum	0.6	0.6	0.8	0.6	0.6	0.9	0.8	0.7	0.7	0.8	0.9	0.7	0.8
Niger seed	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Soybean	8.3	8.9	11.0	9.9	10.0	12.7	12.2	14.7	11.9	10.4	8.6	13.2	11.0
Sunflower	1.4	1.2	1.5	1.2	0.9	0.7	0.5	0.5	0.5	0.4	0.3	0.3	0.2
Rapeseed & mustard	8.1	7.4	5.8	7.2	6.6	8.2	6.6	8.0	7.9	6.3	6.8	7.9	8.3
Linseed	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2
Safflower	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.05
Total nine oilseeds	**28.0**	**24.3**	**29.8**	**27.7**	**24.9**	**32.5**	**29.8**	**30.9**	**32.7**	**27.5**	**25.3**	**31.3**	**31.3**

Source: *Directorate of Economics & Statistics, 2018-19, Department of Agriculture, Cooperation and Farmers' Welfare, First Advance Estimates of Production of Foodgrains for 2018-19*

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