The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Agricultural Economics Research Review 2021, 34 (Conference Number), 21-34
DOI: 10.5958/0974-0279.2021.00012.4

Measuring farmers' welfare: an analysis across states of India

K J S Satyasai*, Ashutosh Kumar, and Neha Gupta

National Bank for Agriculture and Rural Development, Mumbai 400051, Maharashtra

*Corresponding author: satyasaik@outlook.com

Abstract Development literature is replete with comparative studies on the patterns of regional agricultural development and the factors responsible for the regional disparities. Their focus has been on production. However, in recent decades, a paradigm shift has happened away from production to farmers' income, and further to farmers' welfare. This paper identifies multiple indicators of farmers' welfare grouped into (i) production, (ii) post-production, (iii) infrastructure, (iv) social development, (v) ecological aspects, and (vi) policy and fiscal environment, and constructs an index of farmers' welfare for each of the states. Accordingly, we find Punjab ranking the highest and Rajasthan is at the bottom of the index.

Keywords Regional disparity, farmers' welfare index, indicators

JEL Codes Q10, Q13, Q18

Inter-regional variation in economic development is an interesting discourse in the comparative development literature to understand what renders some regions higher on the development continuum and not the others. In India, several studies have explored inter-state variation in agricultural development indicators following different frameworks. A few of them constructed an index to capture a composite view of the inter-state variation in the socio-economic development. NITI Aayog is engaged in evolving an 'Agriculture Transformation Index', for measuring the performance of states across six pillars: (i) inputs (ii) sustainability (iii) productivity and diversification (iv) policy (v) preservation, processing and exports (vi) farmers' income and welfare. Most of these studies have looked at the output and/or input indicators. This approach leaves out certain crucial dimensions because of the changes in policy stance from production to income augmentation, as is reflected in the goal of doubling the farmers' income by 2022. Farmers' Welfare Index can capture the new policy paradigm—at the core of which are the sustainable intensification and increasing farmers' income. Income is an indicator of farmers' welfare, but there are also other dimensions of it. This paper proposes to adopt a farmers' welfare framework to study agricultural development across states. For this purpose, we adapted and extended the concept of farmers' welfare as elaborated in Dalwai (2019).

The remaining paper is organised into different sections elaborating on the concept of farmers' welfare, its dimensions and the indicators, and examining inter-state variation in pre-production and post-production factors; infrastructure -physical, financial and social; policy and fiscal aspects; and ecological factors. State-wise composite Farmers' Welfare Index (FaWI) is discussed in penultimate section followed by conclusions.

Methodology and data

Analytical framework

Dalwai (2019) has listed the following indicators that can reflect farmers' welfare:

- both absolute and relative average income;
- availability and accessibility to social security system – education, health, etc.;
- facilitating the farmer in moving up Maslow's need hierarchy beyond social security

This paper proposes to adopt the farmers' welfare framework in terms of six dimensions viz. (i) production (ii) post-production (iii) infrastructure (iv) social development (v) ecological aspects and (vi) policy & fiscal environment. Production and post-production factors, that can enhance or diminish the welfare of farmers, can include input availability, costs and quality, labour availability and wage rates, output prices, market access, post-harvest facilities, etc. The backward and forward linkages will be more effective if the physical and financial infrastructure such as connectivity, irrigation, power, banking network and penetration, among others are made available to farmers' households. Social infrastructure such as education and health facilities, a network of community organisations, the degree of social capital built up, and so on further add up to the farmers' welfare. Superimposed on these four dimensions are the policy environment and ecological factors that may impact the level of farmers' welfare. Accordingly, we compiled data on various indicators on these six dimensions to understand the level of farmers' welfare across states. We combined these indicators into dimensional indices and then a state-wise composite index of farmers' welfare was worked out. All these indicators are defined such that the higher the value, the higher the farmers' welfare.

We have tried to capture all such dimensions which may influence the state of farmers' welfare (Figure 1). Ranging from the aspects which influence the income outcome such as input availability, government support in marketing and processing to the aspects which may improve productivity like education and health. Availability of good infrastructure facilities like roads and banking that increases the credit absorption capacity, the productivity of inputs along with availability and access to such inputs have also been captured. This aspect is duly incorporated in the framework along with government support under the policy and fiscal environment.

We have identified 90 indicators along the above 6 dimensions and these are listed in Table 1.

The indicators are combined to form dimension indices which, in turn, are combined to construct FaWI. The values of all indicators are normalized to scale down values of indicators between 0 and 1 using the following formula.

$$D_n = (A_n - m)/(M-m) \quad \ldots(1)$$

Where for n^{th} state D_n is the normalized value of the indicator, A_n is the actual value of the indicator, M is the maximum value of the indicator, and m is the minimum value of the indicator.

Indicators are combined to calculate individual dimension indices as

$$P_{n=}(\Sigma w_i * P_i) \quad \ldots(2)$$

$$O_{n=}(\Sigma w_j * O_i) \quad \ldots(3)$$

$$I_n = (\Sigma w_i * I_i) \quad \ldots(4)$$

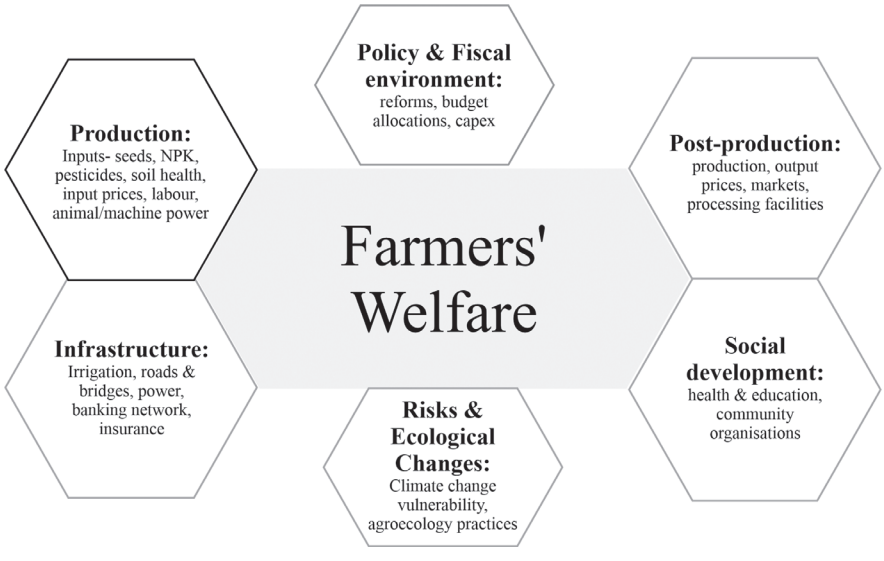

Figure 1 Framework for understanding farmers' welfare

Table 1 Indicators used for constructing FaWI

Dimension	Indicator	Symbol of the indicator	Weight
Production (P)	Number of Soil Health Cards per hectare of Net Sown Area	P1	0.33
	EPWRF Agriculture Index (covering 10 indicators viz. sectoral GVA, pump-sets, energy consumption, etc.)[1]	P2	0.33
	EPWRF Irrigation Index (covering 2 indicators)[1]	P3	0.33
Post-Production	Average monthly agricultural household income from NAFIS survey	O1	0.25
(O)	The ratio of average monthly agricultural household income to non-agricultural household income	O2	0.25
	Total rural primary and wholesale markets per lakh ha of GCA	O3	0.25
	Number of registered/un-incorporated processing units per million value of production	O4	0.25
Physical	Agriculture credit/ha (Rs lakh)	I1	0.143
Infrastructure (I)	Rural branches per one lakh operational holdings	I2	0.143
	NAFINDEX (financial inclusion index covering 18 indicators related to banking products, services and payment mechanisms)[2]	I3	0.143
	Electricity consumption per ha of NSA	I4	0.143
	Electrification index (EPWRF) (covering 3 indicators)[1]	I5	0.143
	Road connectivity index (EPWRF) (covering 1 indicator)[1]	I6	0.143
	Telecommunication index (EPWRF) (covering 1 indicator)[1]	I7	0.143
Social	EPWRF health index (covering 20 indicators)	S1	0.33
development (S)[1]	EPWRF education index (covering 16 indicators)	S2	0.33
	EPWRF drinking water, sanitation and housing index (covering 8 indicators)	S3	0.33
Risks & Ecological	Tree cover and forest cover as % of geographical area	E1	0.50
Changes (E)	Percentage of non-degraded land over total land area	E2	0.50
Policy & Fiscal environment (F)	Public expenditure/operational holding (Rs 000)	F1	1

[1]All these Indices are taken from EPWRF (2021).
[2]Index is taken from Satyasai and Kumar (2020).

$$S_{n=}(\Sigma w_i * S_i) \quad \ldots(4)$$

$$E_{n=}(\Sigma w_i * E_i) \quad \ldots(5)$$

$$F_{n=}(\Sigma w_i * F_i) \quad \ldots(6)$$

Where *i* stands for indicator, *n* stands for each state and *w* stands for the weight assigned to each indicator. All the dimension indices are combined with equal weights to compute FaWI as below:

$$FaWI = P_n + O_n + I_n + S_n + E_n + F_n \quad \ldots(7)$$

Data

The data on various indicators have been collected from various sources: Ministry of Agriculture and Farmers' Welfare, GoI; Dalwai Committee; NABARD All India Financial Inclusion Survey (NAFIS) 2016-17; State and Central Government Departments, etc. Some of the indicators are the dimension indices culled from EPWRF 2021, viz., EPWRF Agriculture Index, EPWRF Health Index, EPWRF Education Index, and EPWRF Drinking Water Sanitation and Housing Index, NAFINDEX.

Results and discussion

Production related factors

Indicators on the production phase and backward

Table 2 State-wise value of indicators included in production dimension

State	Number of soil health cards issued/ha of net sown area	EPWRF irrigation index	EPWRF agri index
Andhra Pradesh	2.3	0.25	0.29
Arunachal Pradesh	0.1	0.06	0.01
Assam	0.6	0.00	0.07
Bihar	2.4	0.50	0.09
Chhattisgarh	1.9	0.14	0.15
Goa	0.3	0.09	0.09
Gujarat	1.3	0.26	0.17
Haryana	2.3	0.89	0.16
Himachal Pradesh	2.4	0.14	0.10
Jharkhand	0.7	0.02	0.07
Karnataka	1.6	0.14	0.21
Kerala	1.5	0.06	0.17
Madhya Pradesh	1.2	0.30	0.10
Maharashtra	1.5	0.08	0.22
Manipur	0.4	0.02	0.03
Meghalaya	1.9	0.22	0.02
Mizoram	0.2	0.04	0.03
Nagaland	0.5	0.09	0.02
Odisha	0.9	0.12	0.13
Punjab	0.6	1.00	0.14
Rajasthan	1.0	0.26	0.09
Sikkim	0.8	0.04	0
Tamil Nadu	2.9	0.35	0.21
Telangana	2.4	0.20	0.24
Tripura	0.9	0.18	0.07
Uttar Pradesh	2.3	0.65	0.12
Uttarakhand	2.3	0.37	0.09
West Bengal	1.6	0.61	0.13

linkages that may influence farmers' welfare cover various factors of production, land, labour and input related aspects (Table 2).

Irrigation plays an important role in deciding the cropping pattern and improving crop yields. Around 78% of fresh water in India is used for agriculture (Gulati 2021) and 48% of the gross cropped area is irrigated. There is a wide disparity in the net irrigated area across states. Assam has only 10% of the net sown area under irrigation while Punjab has 100% of the net sown area under irrigation.

State-wise variation in irrigation is due to the varied geographical conditions in different parts of the country. Rugged mountains, sandy deserts and rocky terrains without aquifers have very poor irrigation facilities, whereas fertile alluvial plains with perennial rivers have higher irrigation intensity. Hence, the highest intensity of irrigation exists in Punjab and Haryana, Western Uttar Pradesh, Bihar, West Bengal and Godavari Krishna Deltas. Haryana and Punjab with nearly 100% irrigated areas have higher irrigation intensity, whereas Assam, Kerala, and Maharashtra, which are rainfed states, are characterised by low irrigation intensity.

There is a wide regional variation in the distribution of soil health cards. While it is very high for southern

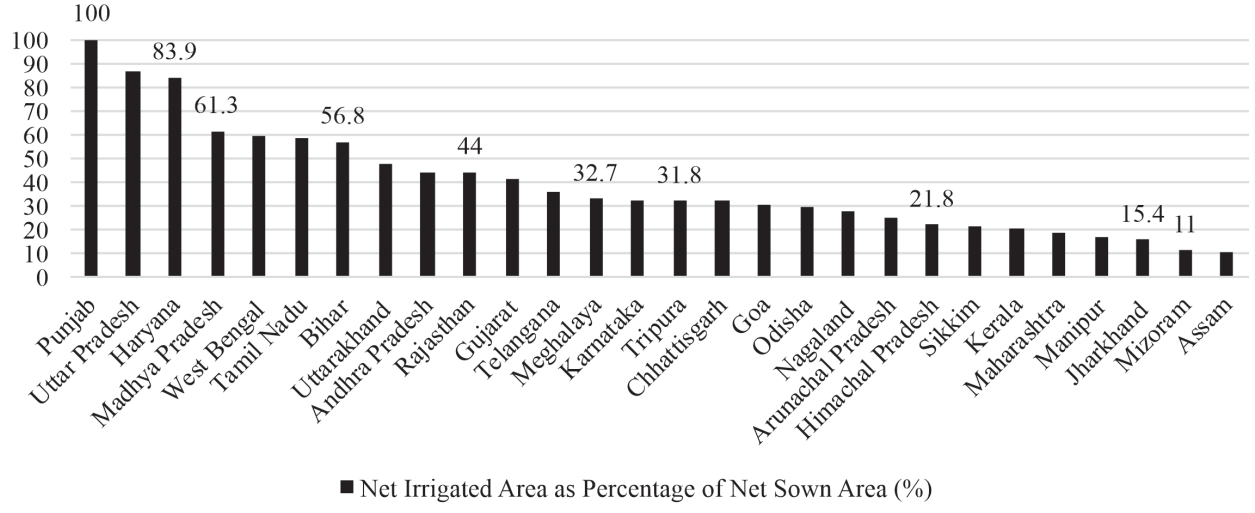

Figure 2 State-wise net irrigated area and net sown area in 2015-16
Source Agriculture Statistics at a Glance, 2019, Directorate of Economics and Statistics, Department of Agriculture Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare.

states (one soil health card per hectare for Tamil Nadu), it stands very low for North-Eastern and Northern states. Punjab which is characterised by the poor health of the soil, had 0.18 soil health cards issued per hectare of net sown area. A high value of SHC/ha of NSA means efficient and effective usage of fertilizers.

Post-production factors

Income is a direct indicator of farmers' welfare, and to compare states on this indicator the state-wise average monthly income per agricultural household as per the NABARD All India Rural Financial Inclusion Survey (NAFIS) 2016-17 has been considered (Table 3). Some of the states like Punjab, Haryana and Kerala have higher average incomes compared to others. It also highlights that the farmers of Bihar, Odisha, Jharkhand, Uttar Pradesh and Madhya Pradesh earn low average monthly income as compared to India's average.

The ratio of agricultural households' income to non-agricultural households' income serves as an important indicator of disparity between agricultural and non-agricultural households (Table 3). The ratio is as high as 2.1 for Punjab and less than 1 for a few states. The higher the ratio, the higher the state ranks in the farmers' welfare index.

Food processing facilities help capture all possible value from food production, bring greater market integration and enable farmers to access assured demand for their produce. This curtails the uncertainty associated with returns from agricultural activity. The higher the processing avenues for primary agri-produce, the better are the chances for a higher share of producers in consumer rupee.

Well-organized marketing infrastructure plays a crucial role in agricultural development, as the marketing system contributes greatly to the monetisation of the farmers' agri-produce (Table 4). An efficient system of price discovery in a market can also act as a catalyst in increasing the farmers' investment for higher productivity and production. The National Commission on Farmers (2007) had recommended that the facility of regulated markets should be available to the farmer within a radius of 5 km. Farmers' income realisation is closely linked to post-production market infrastructure. Small and marginal farmers require good markets nearer to their farms, with robust market linkages.

The total number of rural primary and wholesale markets per lakh hectare of gross cropped area is another indicator of marketing facilities in a state.

Physical and financial infrastructure

Infrastructure acts as an important factor in sustaining the growth of agriculture. This calls for higher Gross Capital Formation (GCF) in agriculture, and also other rural infrastructure including roads, electricity, etc. The condition of rural infrastructure (roads, irrigation and

Table 3 Indicators included in post-production dimension

State	Average monthly income of agricultural household (Ag)	Average monthly income of non-agricultural household (Non-Ag)	Ratio of monthly income of agricultural households/ Income of non-agricultural households	Total rural primary and wholesale markets per lakh ha of GCA	Number of registered/ unincorporated processing units per million value of production
Andhra Pradesh	6920	5296	1.3	4.3	0.2
Arunachal Pradesh	9072	11562	0.8	24.0	0.0
Assam	9878	7985	1.2	27.8	0.2
Bihar	7175	5474	1.3	23.7	0.3
Chhattisgarh	8580	5675	1.5	19.9	0.1
Goa	10687	10760	1.0	17.7	0.3
Gujarat	11899	8617	1.4	2.7	0.1
Haryana	18496	8775	2.1	7.4	0.1
Himachal Pradesh	11828	11402	1.0	8.2	0.2
Jharkhand	6991	4676	1.5	48	0.6
Karnataka	10603	5193	2.0	10.1	0.2
Kerala	16927	14863	1.1	52.1	0.3
Madhya Pradesh	7919	4877	1.6	0	0.1
Maharashtra	10268	8188	1.3	18.8	0.2
Manipur	9861	9435	1.0	31.6	0.2
Meghalaya	10039	10144	1.0	35	0.2
Mizoram	9931	8034	1.2	197.6	0.1
Nagaland	9950	10043	1.0	38.7	0.1
Odisha	7731	6563	1.2	30	0.2
Punjab	23133	10935	2.1	23.1	0.1
Rajasthan	9013	7172	1.3	2.9	0.1
Sikkim	8603	8497	1.0	12.9	0.0
Tamil Nadu	9775	9708	1.0	0	0.4
Telangana	8951	6787	1.3	4.1	0.3
Tripura	7592	9271	0.8	-	0.4
Uttar Pradesh	6668	5565	1.2	15.6	0.2
Uttarakhand	10855	7309	1.5	6	0.2
West Bengal	7756	6383	1.2	36.7	0.3

Table 4 Distribution of states according to market density

Market Density (Area served in sq. km. per regulated market)	States
Less than 100 sq. km.	Nil
101 -200 sq. km.	Punjab, Haryana, WB
201-400 sq. km.	AP, Assam, Maharashtra, Odisha, Karnataka, UP, Jharkhand
601-800 sq. km.	TN, Goa, Gujarat, MP, Chhattisgarh, Rajasthan
801-1000 sq. km.	Uttarakhand, HP

Source Indiastat

electricity) in several states is a matter of serious concern and needs substantial up-gradation for the full realisation of the potential of agricultural growth (Table 5).

With the increasing share of purchased inputs in agriculture, the credit assumes greater importance in augmenting crop yields through the use of high yielding varieties of seeds, fertilizers, pesticides, etc. However, there is a wide inter-state disparity in the availability of agricultural credit. The year-on-year growth is the lowest in the Western, Northern and North-Eastern regions.

Table 5 Indicators included in physical and financial infrastructure dimension

State	Agriculture credit/ha of net sown area (₹ Lakh)	Rural branches per one lakh operational holding	Electricity consumption kWh per ha of NSA	Road connectivity index (EPWRF)	Electrification index (EPWRF)	Tele-communi-cation index	NAFINDEX
Andhra Pradesh	1.81	28.59	1704.5	0.15	0.75	0.12	0.47
Arunachal Pradesh	0.31	68.14	NA	0.01	0.20	0.29	0.36
Assam	0.19	51.35	11.5	0.76	0.39	0.03	0.39
Bihar	0.53	20.65	96.0	0.42	0.24	0.01	0.23
Chhattisgarh	0.27	28.30	893.3	0.04	0.37	0.05	0.09
Goa	0.63	366.67	168.2	0.74	0.11	0.99	0.60
Gujarat	0.62	48.43	1267.0	0.07	0.41	0.17	0.30
Haryana	0.98	102.58	1492.2	0.05	0.91	0.14	0.42
Himachal Pradesh	0.83	122.37	67.5	0.10	0.64	0.37	0.38
Jharkhand	0.30	48.91	116.1	0.06	0.14	0.01	0.30
Karnataka	0.71	41.14	1897.6	0.21	0.70	0.15	0.48
Kerala	3.68	4.81	132.7	0.96	0.72	0.58	0.47
Madhya Pradesh	0.26	23.63	855.4	0.12	0.42	0.04	0.17
Maharashtra	0.35	20.88	1475.1	0.23	0.73	0.14	0.31
Manipur	0.07	60.00	4.8	0.09	0.28	0.04	0.46
Meghalaya	0.07	75.43	NA	0.06	0.39	0.05	0.36
Mizoram	0.09	33.50	NA	0.02	0.52	0.13	0.39
Nagaland	0.06	60.00	NA	0.33	0.47	0.00	0.32
Odisha	0.52	54.79	116.4	0.31	0.48	0.08	0.43
Punjab	1.01	235.22	1431.5	0.34	0.69	0.28	0.49
Rajasthan	0.37	38.42	931.5	0.07	0.72	0.07	0.22
Sikkim	0.13	113.89	NA	0.14	0.59	0.05	0.35
Tamil Nadu	3.71	38.31	2153.0	0.30	0.60	0.34	0.28
Telangana	1.29	26.08	4920.7	0.13	0.98	0.12	0.48
Tripura	0.57	44.50	83.7	0.64	0.64	0.03	0.45
Uttar Pradesh	0.41	33.28	662.6	0.13	0.20	0.02	0.29
Uttarakhand	0.97	109.53	415.7	0.05	0.50	0.10	0.28
West Bengal	0.55	51.84	153.4	0.49	0.61	0.06	0.32

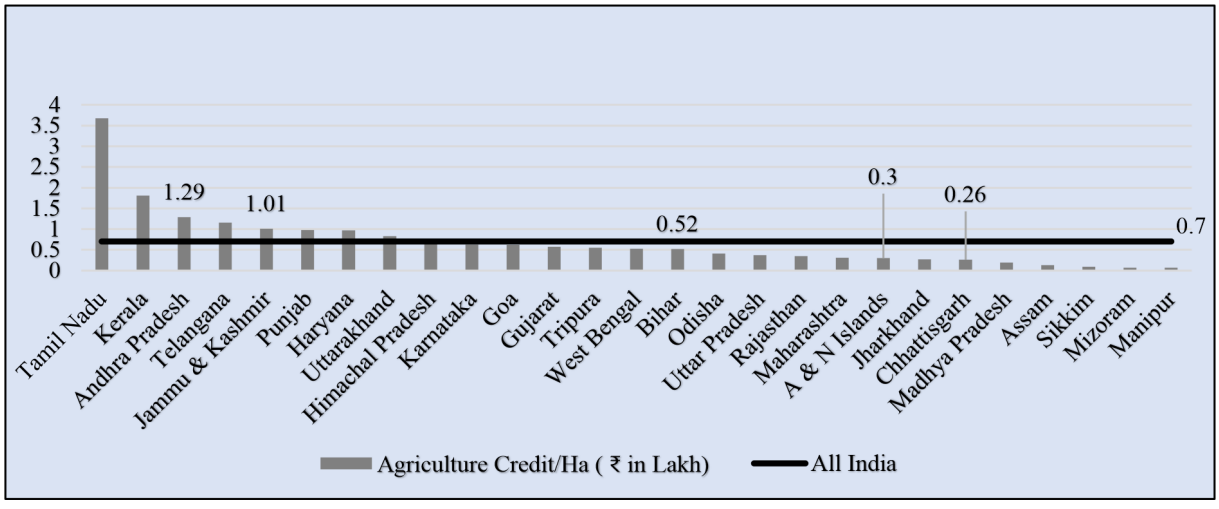

Figure 3 State-wise credit per hectare in 2019-20 (Rs lakh)
Source NABARD

The Southern region has higher credit absorption capacity because of better infrastructure facilities, and better outreach and credit. Normally, the low density of credit delivery outlets and the weak financial health of rural financial institutions could be the constraints for increasing credit flow in credit in the Eastern and Central states (NABARD, 2021).

There is a wide variation in credit per hectare across states. Andhra Pradesh and Punjab have better availability of credit per hectare (Figure 3), and it is less for a larger state like Uttar Pradesh. In this context, the credit absorption capacity of states plays a major role in determining the demand for credit. Tamil Nadu which has the highest credit per hectare also scores high on other indicators like electricity use per hectare and road index. North-Eastern states have very low credit per hectare, and also score low on other indicators of infrastructure.

Road connectivity has the potential to lower input costs, reduce post-harvest losses, and address issues related to the gap between farm-gate price and consumer price. Availability of road network facilitates trade, transportation, social integration and economic development. Poor road connectivity in a state hampers better price realisation, access to marketing avenues and increases the cost of inputs. Hence, it is an important determinant of farmers' welfare.

Agriculture consumes around 20% of the total electricity consumption in the country. However, electricity consumption per hectare varies greatly across states, Telangana 4920 kWh/ha and Bihar 96 kWh/ha (Table 5). The higher electricity consumption per hectare also positively impacts the irrigation levels, although power subsidy leads to inefficient use of power and groundwater extraction leading to alarmingly low levels of groundwater.

NAFINDEX is a multi-dimensional financial inclusion index that has been constructed using three dimensions, traditional banking products, modern banking services, and payment systems. There are variations across states in the value of NAFINDEX and dimension indices. In many states which saw lower penetration of traditional banking products as reflected in the respective dimension index, the modern banking products and payment mechanisms showed higher values. This index acts as a comprehensive indicator for ascertaining the impact of financial infrastructure on farmers' welfare.

Social infrastructure

Access to education and health facilities are central to human wellbeing and happiness. It also makes an important contribution to economic progress, as healthy populations live longer, are more productive, and save more. Education helps in attaining better skills and knowledge leading to higher efficiency and effectiveness.

Table 6 Indicators included in social infrastructure dimension

State	EPWRF Health Index	EPWRF Education Index	EPWRF Drinking Water, Sanitation and Housing Index
Andhra Pradesh	0.48	0.34	0.44
Arunachal Pradesh	0.22	0.32	0.58
Assam	0.38	0.25	0.49
Bihar	0.17	0.24	0.23
Chhattisgarh	0.38	0.34	0.26
Goa	0.57	0.55	0.86
Gujarat	0.33	0.42	0.60
Haryana	0.33	0.64	0.87
Himachal Pradesh	0.37	0.77	0.79
Jharkhand	0.14	0.22	0.05
Karnataka	0.45	0.52	0.54
Kerala	0.47	0.74	0.62
Madhya Pradesh	0.28	0.27	0.18
Maharashtra	0.39	0.46	0.61
Manipur	0.30	0.34	0.59
Meghalaya	0.38	0.10	0.42
Mizoram	0.54	0.46	0.62
Nagaland	0.30	0.34	0.65
Odisha	0.33	0.34	0.05
Punjab	0.50	0.67	0.86
Rajasthan	0.37	0.40	0.42
Sikkim	0.53	0.60	0.97
Tamil Nadu	0.52	0.63	0.40
Telangana	0.46	0.42	0.58
Tripura	0.40	0.35	0.15
Uttar Pradesh	0.26	0.38	0.20
Uttarakhand	0.36	0.67	0.80
West Bengal	0.42	0.29	0.28

The state-wise comparison of education, health and sanitation index brings out interesting insights into the state of farmers' welfare in the states (Table 6). While Tamil Nadu performs exceptionally on the first two indices, it lags behind some states in the drinking water and sanitation index. Haryana scores high on the drinking water, sanitation index and education index but it lags on the health index.

Policy and fiscal ecosystem

Allocations for the agricultural sector have increased significantly over the years, however, much of these are on account of revenue expenditure on development and welfare schemes. It is time to increase allocations for investment in productive capacity; and the priority sectors are research and education, infrastructure

Table 7 State-wise public expenditure on agriculture and allied activities

(Rs crore)

State	2018-19	2019-20	2020-21	Expenditure (2018-19 to 2020-21)/ operational holding (Rs 000)
Andhra Pradesh	8489	6714	6714	8.8
Arunachal Pradesh	800	1178	1079	81.0
Assam	2895	6449	4580	14.9
Bihar	3636	6880	6702	2.9
Chhattisgarh	18020	21470	15607	40.1
Goa	331	536	569	52.8
Gujarat	8367	7785	7778	15.0
Haryana	3392	4409	6045	21.6
Himachal Pradesh	2185	2458	2683	21.5
Jammu & Kashmir	2840	3048	3823	NA
Jharkhand	1788	4229	4585	9.6
Karnataka	20305	21502	15753	21.6
Kerala	6193	6010	6930	7.8
Madhya Pradesh	15603	13233	9579	13.6
Maharashtra	20020	32940	23862	17.2
Manipur	549	875	1113	42.1
Meghalaya	676	1115	1034	34.0
Mizoram	569	709	692	67.5
Nagaland	694	918	895	37.9
Odisha	7843	12104	11554	17.6
Punjab	12343	11777	13193	96.4
Rajasthan	8376	10865	11182	10.6
Sikkim	428	726	611	67.3
Tamil Nadu	12362	14647	15227	16.2
Telangana	12600	21468	25148	22.8
Tripura	733	878	1005	13.2
Uttar Pradesh	12129	10351	11336	7.0
Uttarakhand	2485	2714	3252	27.7
West Bengal	7911	5071	8983	7.7

Source Various issues of state finances: A study of budgets, RBI

development for livestock services, micro-irrigation and land development. During the triennial ending 2019-20 the average expenditure on agriculture and allied sectors per operational holding shows wide variation. States like Bihar, Uttar Pradesh, Kerala, West Bengal, and Andhra Pradesh spend less than Rs96400 per operational holding (Table 7). This inadequate allocation affects the growth of agriculture, income along with private expenditure on investment.

Ecological aspects

Inclusive and sustainable management of natural resources is important for enhancing the farmers'

Table 8 Variation in ecological dimension

State	Tree cover and forest cover as % of Geographical Area	Percentage of non-degraded land in total land area
Andhra Pradesh	0.22	66.19
Arunachal Pradesh	0.26	88.26
Assam	0.27	90.55
Bihar	0.11	87.34
Chhattisgarh	0.41	73.15
Goa	0.82	88.36
Gujarat	0.14	70.00
Haryana	0.01	91.20
Himachal Pradesh	0.20	77.01
Jharkhand	0.36	83.44
Karnataka	0.28	72.52
Kerala	0.77	92.34
Madhya Pradesh	0.29	80.83
Maharashtra	0.26	64.28
Manipur	0.18	61.71
Meghalaya	0.58	71.62
Mizoram	0.47	65.08
Nagaland	0.45	52.95
Odisha	0.35	61.68
Punjab	0.02	96.85
Rajasthan	0.06	47.31
Sikkim	0.06	89.25
Tamil Nadu	0.30	81.24
Telangana	0.20	71.15
Tripura	0.45	90.20
Uttar Pradesh	0.10	89.00
Uttarakhand	0.28	82.32
West Bengal	0.22	94.44

welfare. India is facing a grim situation of desertification and transformation of fertile land into degraded land. The country's Green Revolution pockets are more prone to the problem. The indiscriminate usage of fertilizers, overuse of groundwater and flood irrigation have negatively impacted soil fertility in many states. The percentage of non-degraded land to total area is positively related to farmers' welfare (Table 8). Higher the non-degraded land's share, the higher is the level of farmers' welfare.

Farmers' Welfare Index (FaWI)

In the foregoing sections, inter-state variations in various aspects have been discussed which have bearing on farmers' welfare. In this section, we present a composite index, FaWI combining indicators under six dimensions discussed earlier (Table 9). Farmers' Welfare Index (FaWI) as a composite index of 90 indicators representing six dimensions has a coefficient of variation (CV) of 25% with Punjab at the top with a

Table 9 Farmers' Welfare Index and its dimensions

State	Production	Post-production	Infrastructure	Social development	Ecological dimension	Fiscal dimension	FaWI
Andhra Pradesh	0.47	0.20	0.34	0.42	0.30	0.06	0.30
Arunachal Pradesh	0.07	0.07	0.16	0.37	0.54	0.84	0.34
Assam	0.10	0.26	0.25	0.37	0.57	0.13	0.28
Bihar	0.50	0.26	0.15	0.22	0.46	0.00	0.26
Chhattisgarh	0.34	0.22	0.12	0.33	0.47	0.40	0.31
Goa	0.13	0.22	0.52	0.66	0.82	0.53	0.48
Gujarat	0.31	0.23	0.21	0.45	0.30	0.13	0.27
Haryana	0.62	0.46	0.33	0.61	0.45	0.20	0.45
Himachal Pradesh	0.42	0.23	0.29	0.64	0.40	0.20	0.36
Jharkhand	0.13	0.45	0.10	0.13	0.54	0.07	0.24
Karnataka	0.33	0.39	0.31	0.50	0.39	0.20	0.35
Kerala	0.28	0.40	0.53	0.61	0.84	0.05	0.45
Madhya Pradesh	0.31	0.21	0.15	0.25	0.48	0.11	0.25
Maharashtra	0.31	0.23	0.26	0.49	0.30	0.15	0.29
Manipur	0.05	0.22	0.15	0.41	0.24	0.42	0.25
Meghalaya	0.30	0.20	0.15	0.30	0.53	0.33	0.30
Mizoram	0.05	0.44	0.16	0.54	0.42	0.69	0.38
Nagaland	0.13	0.18	0.18	0.43	0.28	0.37	0.26
Odisha	0.20	0.22	0.22	0.24	0.32	0.16	0.23
Punjab	0.44	0.57	0.42	0.68	0.51	1.00	0.60
Rajasthan	0.27	0.17	0.21	0.40	0.03	0.08	0.19
Sikkim	0.13	0.09	0.21	0.70	0.45	0.69	0.38
Tamil Nadu	0.52	0.24	0.44	0.52	0.49	0.14	0.39
Telangana	0.46	0.24	0.44	0.49	0.34	0.21	0.36
Tripura	0.26	0.17	0.29	0.30	0.66	0.11	0.30
Uttar Pradesh	0.53	0.18	0.14	0.28	0.47	0.04	0.27
Uttarakhand	0.48	0.29	0.22	0.61	0.49	0.27	0.39
West Bengal	0.46	0.28	0.25	0.33	0.58	0.05	0.33

value of 0.60 and Rajasthan at the lower end with a value of 0.19. Among the dimensions, variation in fiscal dimension was maximum with a CV of 94%.

Conclusions

Approximately 70% of the Indians live in rural areas and are mostly engaged in agriculture and allied activities for their livelihood. Although the share of agriculture in the total gross domestic product (GDP) has been declining, the performance of the economy and the standard of living of a large section of the population depends on the growth in the agricultural sector. Therefore, it is imperative to reduce employment pressure on agriculture by improving inter-sectoral market linkages and shifting the labour force from the farm to the non-farm sector. Also, the level of agricultural development varies from region to region. Except for the states of Punjab, Haryana and Western Uttar Pradesh where the green revolution resulted in

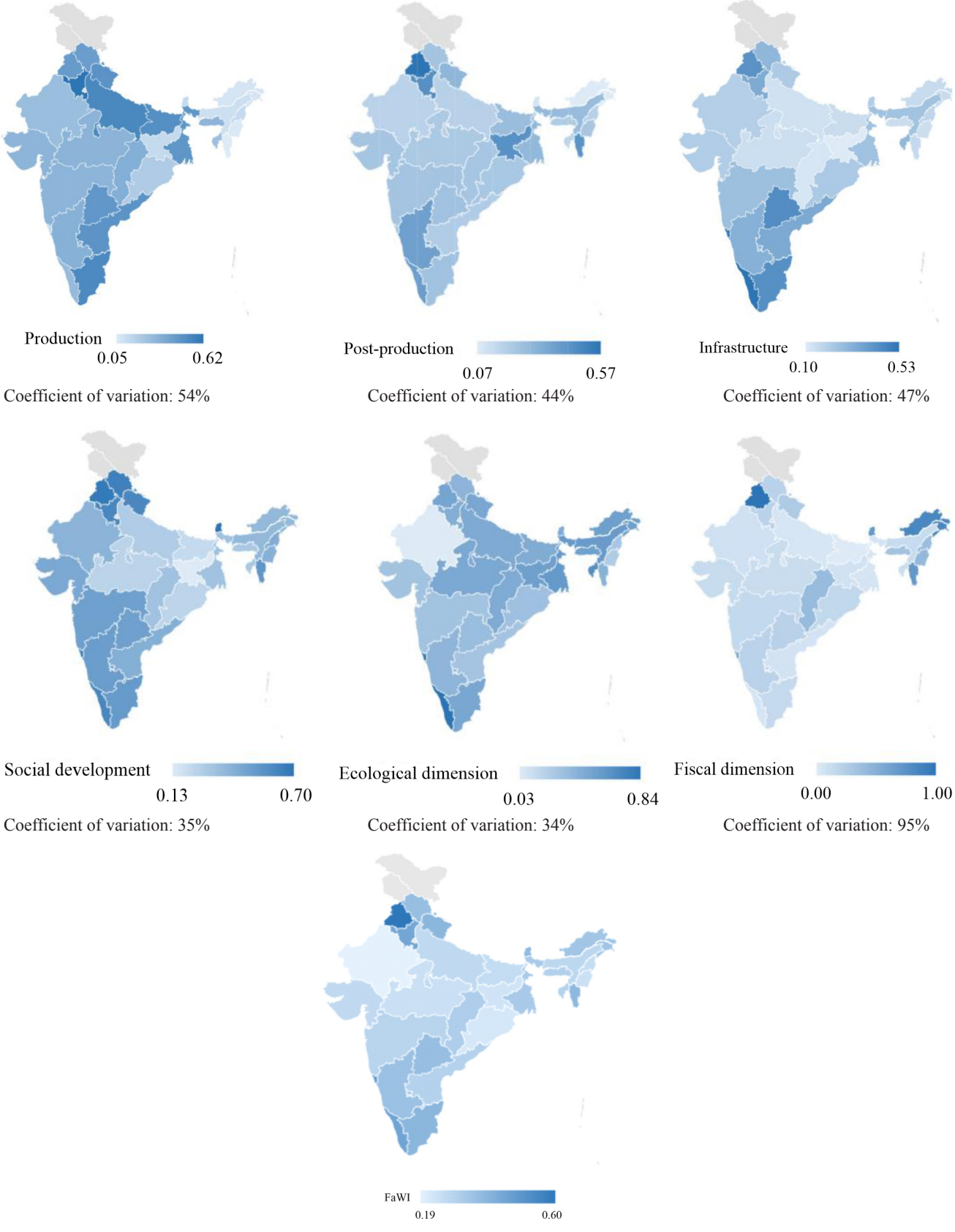

Figure 4 Spatial pattern of Farmers' Welfare Index (FaWI) and its dimensions

higher output mainly for wheat and paddy due to the adoption of technologies, HYV seeds and assured irrigation, most of the states are associated with low levels of agricultural productivity and per capita output. The human capital (rural literacy), physical capital (tractor, pump set and other farm machinery), rural infrastructure (irrigation facilities, rural connectivity, digital connectivity, market facilities, etc.) and access to credit have effects on the growth rates of agricultural development. Hence, higher investment for the creation of infrastructural facilities on the above factors with a special focus on the eastern and North Eastern states could be an effective way of achieving high growth rates and reducing regional disparities in agricultural development.

In this paper, we adopted a farmers' welfare framework and attempted to capture the inter-state variation in agricultural development discussed in the foregoing paragraph from a different paradigm. We constructed a Farmers' Welfare Index (FaWI) as a composite index of 90 indicators representing six dimensions. The results revealed variation (Coefficient of Variation of 25%) in the Index with Punjab at the top with a value of 0.58 and Rajasthan at the lower end with a value of 0.19. Variations in fiscal dimension were maximum with a CV of 94%. This study is expected to spur further debate and encourage more researchers to undertake studies for improvising on the methodology and scope as we move forward.

[The views expressed in the paper are authors' own and other usual disclaimers apply]

References

Dalwai, A. 2019. Farmers' Welfare and Income Revolution, *Lalit Doshi Memorial Lecture, Mumbai.*

EPWRF 2020. Construction of State-wise Rural Infrastructure Indices (RIIs) & A Scheme of Rural Infrastructure Development Fund (RIDF) Allocation. NABARD Research Series-13. *EPW Research Foundation, Mumbai*. *https://www.nabard.org/auth/writereaddata/tender/1007211141NRS-13-%20Construction%20of%20State-wise%20RIIs%20&%20Scheme%20of%20RIDF%20Allocation.pdf*

Gulati, A. 2021. Make every drop of water count for sustainable agriculture. *Indian Express*. https://indianexpress.com/article/opinion/columns/india-farmers-water-supplies-irrigation-mgnrega-conserve-water-catch-the-rain-campaign-7249646/

GoI-Government of India. 2018. *Report of the Committee on Doubling Farmers' Income*. Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, New Delhi (Chairman: Ashok Dalwai). https://agricoop.nic.in/en/doubling-farmers

NABARD. 2021. Annual Report 2020-21. https://www.nabard.org/nabard-annual-report-2020-21.aspx

Pal, S, and P S Birthal. 2021. Budget 2021-22: some suggestions, in ICAR-NIAP Agricultural Development Report 2020-21. *ICAR-National Institute of Agricultural Economics and Policy Research*, New Delhi.

Raju, S S, R Chand, and M J Bhende. 2008. Agricultural Insurance in India: Problems and Prospects. *National Centre for Agricultural Economics and Policy Research*. https://doi.org/10.2307/4419629.

Satyasai, K J S, and A Kumar. 2020. NAFINDEX: Measure of Financial Inclusion based on NABARD All India Rural Financial Inclusion Survey (NAFIS) Data. NABARD Working Paper: 2020-1. https://www.nabard.org/auth/writereaddata/tender/1008204111WP2020_1.pdf