Research Article

ANALYSIS OF SUSTAINABLE PATH FOR FOOD SECURITY IN INDIA

V. Rajendra Prasad and D. Vishnu Sankar Rao

Acharya N.G.Ranga Agricultural University Department of Agricultural Economics
Agricultural College, Naira-532185 Andhra Pradesh (India)

A R T I C L E   I N F O

A B S T R A C T

Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Prioritizing and quantifying the contribution of food security related activities will help us in making fruitful decisions. Hence a study has been under taken with the objective to develop sustainable path in various contingent situations for agricultural development in general and food security in particular. Critical factors of input and allied component, central allocation component, climate and stocks component and storage component that were obtained through data reduction, were considered as independent variables to find out their direct and indirect contribution towards the household food security in India during 1991-92 to 2009-10. Annual central allocation on plantation (1.1731), expenditure incurred for food storage (1.2826) and poultry production (1.2332) were the factors that had significant direct affect and annual central allocation to agricultural research and education (-1.7980) had direct negative effect on household food security of India.

INTRODUCTION

Food security was defined in the World Food Summit (1974) as the availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices. In 1983, FAO expanded its concept to include securing access by vulnerable people to available supplies, implying that attention should be balanced between the demand and supply side of the food security equation. Food security also meant "ensuring that all people at all times have both physicaland economic access to the basic food that they need" and also "access of all people at all. The abstract of the article was read in Global Food Symposium, 2014 held at University of Gottingen, Germany times to enough food for an active, healthy life.

By the mid-1990s food security was recognized as a significant concern, spanning a spectrum from the individual to the global level. However, access now involved sufficient food, indicating continuing concern with protein-energy malnutrition. But the definition was broadened to incorporate food safety and also nutritional balance, reflecting concerns about food composition and minor nutrient requirements for an active and healthy life. Food preferences, socially or culturally determined, now became a consideration.

Corresponding author: **V. Rajendra Prasad**
Acharya N.G.Ranga Agricultural University Department of
Agricultural Economics Agricultural College, Naira-532185
Andhra Pradesh (India)

The potentially high degree of context specificity implies that the concept had both lost its simplicity and was not itself a goal, but an intermediating set of actions that contribute to an active and healthy life. The World Food Summit (1996) adopted a still more complex definition:"Food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". This definition is again refined in the state of food insecurity in 2001: "Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".

In India, per capita net availability per day has reduced from 468.5 gm in 1991 to 438 gm in 2010. Reduction in availability will increase the prices of food grains. A mix of high oil and fuel prices, growing use of bio fuels, bad weather and soaring futures markets pushed up prices of food in 2007-08 prompting violent protests in countries including Egypt, Cameroon and Haiti. According to Jaques Diouf, Director General of FAO, higher food prices and their volatility will continue in the next years if we fail to tackle the structural causes of imbalances in the international agricultural system. Government investment, budgetary expenditure and domestic and foreign private investment on agriculture should be increased besides addressing certain trade related issues such as commodity futures, support of OECD countries *etc.*

Central government in India would be spending its allocations for agriculture among various investment and expenditure activities. Taking into consideration the limited availability of the resources meant for the above activities prioritizing and quantifying the contribution of these activities towards agriculture development in general and food security in particular will help us in making fruitful decisions pertaining to agriculture. Hence a study has been under taken with the following objectives.

1. To identify the major components affecting food security in India.
2. To prioritize the components affecting food security in India.
3. To develop a path for sustainability food security of India

METHODOLOGY

Data regarding annual sector wise allocation by the central government, private, public and total gross capital formation, area, production and productivity of food grains, agricultural exports and imports, season wise rainfall, expenditure on seed, NPK, pesticides, marine, inland and total fish production, electricity, Subsidies on fertilizer, electricity, irrigation and others and their total, stocks of Rice, Wheat, Coarse cereals and their total and institutional credit for agriculture were collected for the period from 1990-90 to 2009-10 from the official website of Department of Agriculture and Cooperation, GOI.

Efforts were made to know the contribution of individual variable as per the data collected through Multiple Linear Regression (MLR). Owing to the more number of variables and multi co-linearity among the collected independent variables it was not possible to conduct MLR. Hence Principle Component Analysis (PCA) was attempted to conveniently divide the variables into a limited number of components containing groups of meaningful variables.

Principle Component Analysis

The central idea of principal component analysis (PCA) is to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This is achieved by transforming to a new set of variables, the principal components (PCs), which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all of the original variables.

If we take the standard regression model

$Y = x_i \beta + \gamma$

And consider instead the PCA rotation of X given by

$Z = ZA$

then we can rewrite the regression model in terms of the PC's

$Y = Z \gamma + \varepsilon$

We can also consider the reduced model

$Y = Z_q \gamma_q + \varepsilon_q$

Where only the first q PC's are retained.

Sub components of the PC's were considered for MLR to meaningfully analyse their contribution towards the food security. For this purpose, those years in which the annual increase in growth rate of the population exceeds the annual increase in food production were considered as food insecure

years and were allotted '0' value as dependent variable and '1' for food secure years. Analysis was carried out using SPSS 10.0 statistical package.

Path Coefficient Analysis

Path Coefficient Analysis was employed and the resultant correlation coefficients will be utilized to know the direct and indirect contribution of various factors/ components/ sub components as suggested by Wright (1921). The following set of simultaneous equations were formed and solved for estimating various direct and indirect effects on food grain production in Andhra Pradesh.

$$r1p = r_{11}P_{1A} + r_{12}P2A + r_{13}P3A + \dots\dots + r_{ii}PiA$$
$$r2p = r_{21}P_{2A} + r_{22}P_{2A} + r_{23}P_{3A} + \dots\dots + P_{iY}$$
$$r3p = r_{i1}P_{1A} + r_{i2}P_{2A} + r_{i3}P_{3A} + \dots\dots + P_{iY}$$

Where,

r_{1A} to r_{iA} = Coefficient of correlation between causal factors 1 to i and dependent character Production.

r_{i1} to r_{ii} = Coefficient of correlation among causal factor
P_{1A} to P_{iA} = Direct effects of character 1 to i on character Y
The direct effects were calculated as follows

$$P_{1A} = \sum_{i=1}^{k} = C_{1i} r_{iA}$$

$$P_{2A} = \sum_{i=1}^{k} = C_{2i} r_{iA}$$

$$p_{iA} = \sum_{i=1}^{k} = c_{1i} r_{iA}$$

The indirect effects were given by r_{ij}

Unexplained variance (Residual) not accounted by the variables included could be obtained by the formula

$P_{RY} = \{1-(P1y\ r1y+p2yr2y)\}^{1/2}$

The correlation coefficient between household food security and each of the independent variables (riy) will be tested for significance by students' t test

$t=|r|\ (n-2)^{1/2}/\ (1-r^2)^{1/2}$ where
r= correlation coefficient
n= number of years

As per the scales proposed by Lenka and Mishra (1973) the direct and indirect effect was considered on scale ranging from negligible to very high (0.00 to 1.00) depending on the value of the coefficients.

RESULTS AND DISCUSSION

The component matrix after extraction for the variables analyzed through principal component analysis was presented in Table 1. Seven principal components were extracted out of the forty six variables considered for the study. The nature of each principal component was studied based on the factor loadings of independent variables in it. Variable with more than or equal to the value of 0.5 were selected to study the nature of the seven principle components that were extracted. A close observation of the table 1 revealed that the first PC included the expenditure on agriculture inputs and allied sector with 54.425 per cent variation in the data. Similarly,

PC2 involved the expenditure allocation of central government public sector to various agricultural and allied sector activities explaining around 13 per cent variation in the data collected. PC3 and PC4 constitute climate & stock component and storage component. These explained a variation of 9.299 and 6.244 variation respectively in the variables selected for the study. The remaining components enveloped certain irregular combination of variables explaining 9.246 percent of variation in the data. By the above discussion it can be concluded that the expenditure on agriculture inputs and allied sector, expenditure allocation of central government to various agricultural and allied sector activities, climate & stock component and storage component are the important components that were influencing the agricultural development in India. A careful study of these components for their contribution and judicious packaging of these components in various agricultural development policies is very much needed for the sustainable agricultural development leading to the comprehensive food security of India. In order to avoid vague conclusions by attempting to study the contribution of these principal components towards the food security, efforts were made to split these principal components into meaningful sub components. This exercise was carefully accomplished as more number of sub components with in a principal component (whatever may be its meaningfulness and desirability) might pose the multico linearity problem and consequent error in the results.

The details of the nature of the principal components that were extracted, the respective percent of variance explained by them, cumulative variance thus obtained and the nature of the sub components considered for further analysis were presented in the table 2.

The PC 1 i.e., input and allied component was split into central allocation to the various agricultural and allied activities, production and yield of food grains, agricultural imports, inputs used, production in the allied sector and subsidies spent on the agriculture infrastructure. The importance of allied activities was emphasized by Ciamarra and Otte (2010) in the form of public investments in support of backyard poultry farming development which is important for enhancing nutritional status and reducing vulnerability of many rural households. Agricultural infrastructure included was electricity (GWh), fertilizer subsidies, electricity subsidies, irrigation subsidies, other subsidies and total subsidies. The PC 2 is the central allocation to the activities like crop husbandry, animal husbandry, plantation, agricultural research & education and other agricultural programmes. The interrelationship between the sub component of rainfall and the stocks of the cereals was reflected in the extraction of the PC 3.

Table 1 Factor loadings of the independent variables in the principal component matrix

Variable		1	2	3	4	5	6	7
Crop Husbandry		**0.975**	0.037	0.050	0.162	0.095	0.016	0.052
Soil & Water Conservation		0.112	**0.950**	0.023	0.034	0.131	0.127	0.119
Animal Husbandry		**0.846**	0.436	0.077	0.203	0.112	0.111	0.023
Dairy Development		**0.755**	**0.516**	0.058	0.259	0.009	0.095	0.000
Fisheries		0.106	**0.859**	0.051	0.162	0.103	0.349	0.154
Forestry & Wild Life		0.235	**0.875**	0.175	0.026	0.145	0.176	0.165
Plantation		**0.944**	0.112	0.007	0.180	0.072	0.005	0.044
Food Storage & Warehousing		0.324	**0.548**	0.204	**0.483**	0.060	0.127	0.284
Agriculture, Research & Education		**0.979**	0.155	0.002	0.083	0.035	0.043	0.005
Cooperation		0.378	**0.566**	0.014	**0.583**	0.115	0.069	0.288
Other Agricultural Programmes		**0.790**	0.188	0.229	0.048	0.127	0.422	0.168
GCF in Agriculture & Allied Sector	Public	**0.915**	0.218	0.118	0.241	0.068	0.012	0.054
	Private	0.628	0.446	0.097	0.198	0.316	0.414	0.041
	Total	**0.920**	0.232	0.130	0.244	0.031	0.057	0.057
Food grains	Area (m.ha)	0.186	0.374	**0.659**	0.217	0.249	0.206	0.083
	Production(m.t)	**0.852**	0.018	0.332	0.267	0.071	0.145	0.066
	Yield(Kg/ha)	**0.921**	0.069	0.188	0.223	0.022	0.101	0.086
	Agricultural exports	0.254	0.118	0.115	0.174	0.407	0.535	0.158
	Agricultural imports	**0.968**	0.108	0.062	0.045	0.063	0.029	0.091
	Monsoon Season	0.035	0.129	**0.781**	0.447	0.129	0.011	0.215
	Post-Monsoon	0.279	0.395	**0.627**	0.167	0.056	0.158	0.187
	Winter Season	0.148	0.113	0.129	**0.497**	0.446	0.057	**0.436**
	Pre-monsoon Season	0.413	**0.619**	0.487	0.115	0.296	0.401	0.010
	Over all rainfall	0.152	0.171	**0.858**	0.294	0.124	0.016	0.282
	Seed	**0.977**	0.170	0.079	0.015	0.018	0.455	0.025
Fertiliser	N	**0.944**	0.037	0.043	0.216	0.178	0.028	0.128
	P	**0.910**	0.013	0.056	0.038	0.011	0.223	0.265
	K	**0.921**	0.199	0.036	0.085	0.028	0.132	0.124
	Total	**0.962**	0.074	0.001	0.121	0.101	0.086	0.171
	Pesticides	**0.860**	0.441	0.036	0.049	0.158	0.135	0.014
Variable		1	2	3	4	5	6	7
Fish production(Lakh tonnes)	Marine	**0.705**	0.267	0.060	0.264	0.294	0.069	0.121
	Inland	**0.990**	0.066	0.021	0.028	0.027	0.031	0.063
	Total	**0.976**	0.106	0.029	0.025	0.078	0.039	0.076
Milk	(Million Tonnes)	**0.985**	0.110	0.027	0.047	0.069	0.076	0.019
Eggs	(Billion Nos.)	**0.981**	0.013	0.035	0.011	0.049	0.098	0.045
Electricity	GWh	**0.811**	0.200	0.244	0.294	0.361	0.108	0.021
Subsidies	Fertiliser	**0.855**	0.371	0.053	0.161	0.158	0.210	0.014
	Electricity	**0.921**	0.187	0.084	0.250	0.005	0.074	0.055
	Irrigation*	**0.977**	0.037	0.037	0.153	0.011	0.058	0.066
	Others	**0.747**	0.512	0.079	0.101	0.168	0.291	0.008
	Total	**0.871**	0.330	0.059	0.203	0.157	0.176	0.021
Stocks (Million tonnes)	Rice	0.289	0.359	0.627	0.487	0.057	0.059	0.251
	Wheat	0.203	0.380	0.694	0.488	0.141	0.107	0.164
	Coarse Cereals	0.233	0.072	0.264	0.123	0.691	0.129	0.389
	Total	0.230	0.387	0.680	0.497	0.135	0.075	0.207
Institutional credit		**0.945**	0.238	0.068	0.129	0.046	0.070	0.015
Variance explained (%)		**54.425**	13.171	9.299	6.244	3.635	3.166	2.445
Cumulative Variance (%)		**54.425**	67.595	76.894	83.138	86.773	89.939	92.384

Note: Highlighted figures are the variables included for describing the principal component analysis

The storage of the rice and the production of the wheat, the staple foods were dependent on the winter season rainfall and hence their extraction in the form of the PC 4. From the table 2 it is evident that the central allocation to various activities of agriculture and allied sector, area and production of food grains, agricultural inputs, production of the allied sector, subsidies spent on the agricultural infrastructure, GCF in agriculture, stock of food grains, and expenditure on the storage and ware housing were the important sub components that might affect the sustainable agricultural development leading to comprehensive food security of India.

production and the food grain stocks mainly Rice and Wheat were significantly contributed to the food security. Their very low contribution might be viewed in the context of the requirement of comprehensive and multipronged approach in ensuring food and nutritional security. Moreover, even a slight increase in their allocation (in case of GCF, stocks) or slight rise in the production would have massive implications in terms of welfare of the people. Remaining components are either negative or non significant for their contribution towards food security of India.

Table 2 Important sub components affecting the agricultural development in India

Sub component	PC 1	Sub component	PC 2	Sub compo-ent	PC 3	PC 4	PC 5
	Input and allied component		**Central allocation component**		**Climate and stocks Component**	**Storage component**	**Remaining component**
Central allocation	Crop Husbandry, Animal Husbandry, Plantation, Agriculture, Research & Education and other Agricultural programmes	Central allocation	Soil and water conservation, Diary development, Fishery, Forestry, Food storage and co-operation	Rainfall	Area (m.ha) Monsoon Season, Post Monsoon and Over all rainfall	Food Storage & warehousing, Cooperation and Winter season rainfall	
Capital employed	GCF in Agriculture & Allied Sector (Public and Total)			Stock component	Rice, Wheat and Total stock of food grains		
Food grains	Production(m.t) Yield(Kg/ha)						
Agricultural imports and Inputs	Agricultural imports, Seed, N, P, K, Total NPK and Pesticides						
Allied sector	Marine Fish, Inland Fish, Total Fish, Milk (Million Tonnes) and Eggs(Billion Nos.).						
Subsidies	Electricity (GWh), Fertiliser subsidies, Electricity subsidies, Irrigation subsidies and others subsidies and total subsidies						
Variance explained (%)	54.425		13.171		9.299	6.244	9.246
Cumulative Variance (%)	54.425		67.595		76.894	83.138	92.384

Multiple linear regressions were conducted with the hypothesis that there is significant regression between the sub components and the food security of India. The results presented in the table 3 revealed that there is significant regression between the selected sub components or variables and food security dummy. The negative intercept value indicated the importance of the selected sub components in ensuring food security of India. That means in the absence of all of

Table 3 Factors affecting the food security in India

Variable (Sub component)	Coefficients	Standard Error	t Stat
Intercept	-2.78664	2.758292	-1.01028
Total GCF	3.32E-05*	1.68E-05	1.977001
Production	0.032739*	0.011004	2.975186
Imports	1.89E-05	6.65E-05	0.283282
Inputs	-0.00241	0.006567	-0.36631
Fish production(Lakh tonnes)	0.04165	0.081011	0.514132
Milk (Million Tonnes)	-0.05872	0.110108	-0.53328
Eggs (Billion Nos.)	-0.05272	0.098062	-0.53764
Subsidies to agriculture	6E-07	7.95E-06	0.075458
Stocks of food grains	0.033665*	0.013697	2.457844
Institutional credit	-8.8E-06	8E-06	-1.10249

$R^2 = 0.71514$, n=19, F tab (0.1) =2.538, t tab (0.1) = 1.734

these factors the country might face food insecurity. The sub components viz., total gross capital formation, food grain

These results were reinforced by the results obtainrd by Ninno *et al* (2007) suggested that food aid that supports building of production and market enhancing infrastructure, is timed to avoid adverse price effects on producers, and is targeted to food insecure households can play a positive role in enhancing food security. However, food aid is not the only, or in many cases, the most efficient means of addressing food insecurity.

Study of interactions affecting food security in India

The path coefficient analysis was attempted taking the house hold food security level i.e. percent of households that consumed more than ninety percent of the recommended calorie intake as dependent variable. Critical factors of input and allied component, central allocation component, climate and stocks component and storage component that were obtained in earlier studies, were considered as independent variables to find out their direct and indirect contribution towards the household food security in India during 1991-92 to 2009-10. Moreover, with the recent shift to a more market-oriented and outward-looking macro-policies, the poor are likely to be exposed to the resultant risk of market uncertainties. As a result several types of programmes need to be targeted exclusively to the poor aimed to (i) eliminating transient food insecurity on account of inadequate access to food in periods of crises (ii) reducing chronic food insecurity

by enhancing their capabilities to participate in the growth process (iii) reducing malnutrition among pre-school children and women and (iv) improving basic services (safe drinking water, health care etc.) to the poor. Hence, the above independent variables were to consider finding out their direct and indirect contribution towards the household food security of India with the objective to propose paths for attaining sustainable food security in India. The study period from 1992-2010 was considered as two treatments by conveniently dividing it as early reform (1992-2000) and post reform periods (2001-2010). The results of the path coefficient analysis with two treatments of nine replications each and sixty seven independent variables against the household food security level as percent are presented in Appendix. The important factors and parameters which had high to very high direct positive effect along with their associated paths involving indirect positive and negative effects are discussed here under.

Annual central allocation on plantation

Annual central allocation on plantation had high direct positive effect on household food security in Andhra Pradesh (1.1731). Its indirect positive effect was through agriculture research (1.137), fertilizer (Total) (1.1261), poultry (1.1251), eggs (1.1228), milk (1.1217), P (1.1178), buffalo (1.117), Inland (1.1103), crop husbandry (1.1089), Irrigation (1.1037), agricultural imports (1.1029), K (1.1004), total stock (1.0833), N (1.082), Sheep (1.0675), animal husbandry (1.0463), subsidy (1.0448), agricultural export (1.0417) and electricity subsidy (1.0393). Its indirect negative effect was through cattle (-1.0718) and total bovines (-1.12).

Expenditure incurred for food storage

Expenditure incurred for food storage had high direct positive effect on household food security in Andhra Pradesh (1.2826). Its indirect positive effect was through N (1.2143), K (1.1908), Fertilizer (Total) (1.1819), Agricultural exports (1.1697), eggs (1.168), total stocks (1.1651), milk (1.1648), inland (1.1616), agricultural imports (1.157), subsidy (1.156), P (1.1555), Seed (1.1545), poultry (1.1444), irrigation (1.1428), buffalo (1.1355), electricity subsidy (1.1309), agriculture research (1.1277), yield (1.087), crop husbandry (1.0856), sheep (1.084) and GCF in agriculture (1.0828), plantation (1.0434) and marine fish (1.0339). Its indirect negative effect was through total bovines (-1.1395) and cattle (-1.2032).

Poultry production

Poultry production had high direct positive effect on household food security in Andhra Pradesh (1.2332). Its indirect positive effect was through milk (1.2274), eggs (1.2266), inland fish (1.2256), agriculture research (1.2245), buffalo (1.2244), fertilizer (Total) (1.2223), total stock (1.2145), agricultural imports (1.2074), crop husbandry (1.2007), P (1.195), N (1.1891), K (1.1856), irrigation (1.183), plantation (1.1826), sheep (1.1698), subsidy (1.1594), electricity subsidy (1.1564), agricultural exports (1.1559), seed (1.1367), yield (1.1164), food storage (1.1003), animal husbandry (1.074), GCF in Agriculture (1.0568), goats (1.0181) and production (1.0102). Its indirect negative effect was through other agricultural programmes (1.0022), cattle (-1.1572) and total bovines (-1.2277).

Sustainable path proposed for food security in India

So far, it was inferred about the direct and indirect effects of factors towards the household food security of India. However, a perusal of important direct effects both negative and positive towards household food security of India revealed that annual central allocation on plantation (1.1731), expenditure incurred for food storage (1.2826) and poultry production (1.2332) were the factors that had significant direct affect and annual central allocation to agricultural research and education (-1.7980) had direct negative effect on household food security of India. Indian researchers like Sen *et al* (2002) analyzed the inter-sectoral linkages using a computable general equilibrium model based on a SAM constructed, from Indian national accounts data for 1988-89. The model includes the rural non-farm sector, public sector production and aspects of public policy. Evidences developed by them supported the importance of broad based agricultural development as opposed to increased production in the food sector alone aimed at achieving food self-sufficiency. David *et al* (2012) narrated similar strategies of specific pro-nutrition actions into other sectors and development areas such as health, food security and agriculture, gender, social protection, education, and water and sanitation. The main aim of conducting path analysis for the critical factors obtained through data reduction of input and allied component, central allocation component, climate and stocks component and storage component as the important factors to be considered to assess the food security situation in a system, is to suggest certain paths involving important factor with strong direct positive effect backed by supplementary factors with positive indirect effects which could be used by the policy makers as the strategies and schemes under different contingent situations. The details are

Table 4 Identification of factors showing direct effects towards household food ecurity in Andhra Pradesh.

Factors	Direct effect	Factors	Direct effect
Crop Husbandry	0.5444	Pesticides	-0.4594
Animal Husbandry	-0.1134	Marine fish	-0.0344
Plantation	1.1731	Inland fish	-0.1264
Agriculture Research	-1.798	Total fish	-0.2442
Other Agricultural programmes	-0.1038	Area	-0.3483
Soil and water conservation	-0.1100	Production	0.5176
Co-operation	-0.4117	Yield	-0.3301
Food storage	1.2826	Agricultural exports	-0.4433
Forestry	0.2738	Cattle	0.4106
Fishery	0.3353	Buffalo	0.6600
Diary development	-0.0744	Total Bovines	0.965
Monsoon Season rainfall	0.5662	Sheep	-0.0281
Post Monsoon rainfall	-0.431	Goats	0.4633
Over all rainfall	0.0434	Poultry	1.2332
Winter rainfall	0.2065	Milk	-0.1856
GCF in Agriculture	-0.6191	Eggs	0.3846
Rice	0.2907	Procurement	0.6280
Wheat	-0.5724	Food subsidy	-0.2024
Total stock of food grains	0.8327	Fertilizer (Total)	-0.3719
Agricultural imports	-0.0183	Electricity subsidy	-0.2177
Seed	-0.7309	Irrigation	-0.0119
N	-0.0997	Subsidy	-0.5276
P	-0.9261	Pesticides	-0.4594
K	0.3863	Marine	-0.0344

given here under. Similar strategy was suggested by Dev (1996) while examining the poverty and food security problem in Maharashtra and West Bengal, India, proposed a similar path involving improvements in targeting and delivery systems in rural areas for efficient PDS and concluded that a combination of policies,

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Appendix. Path co-efficient matrices of factors affecting the house hold food security in Andhra India

Factors	Crop Husbandry	Animal Husbandry	Plantation	Agriculture Research	Other Agricultural Programmes	Soil and water conservation
Crop Husbandry	**0.5444**	0.4935	0.5146	0.5258	0.4623	-0.2912
Animal Husbandry	-0.1028	**-0.1134**	-0.1011	-0.103	-0.1059	0.0205
Plantation	1.1089	1.0463	**1.1731**	1.137	0.9557	-0.546
Agriculture Research	-1.7364	-1.6343	-1.7426	**-1.798**	-1.516	0.8208
Other Agricultural Programmes	-0.0881	-0.097	-0.0845	-0.0875	**-0.1038**	0.0035
Soil and water conservation	0.0589	0.0199	0.0512	0.0502	0.0037	**-0.11**
Co-operation	0.1965	0.0476	0.1722	0.194	0.0121	-0.3504
Food storage	1.0856	0.9284	1.0434	1.1277	0.784	-0.82
Forestry	-0.0307	0.0691	0.0016	0.0013	0.0942	0.222
Fishery	-0.0099	0.1038	-0.002	-0.0015	0.0966	0.1693
Diary development	-0.0587	-0.0651	-0.0545	-0.0554	-0.0684	0.0032
Monsoon Season rainfall	-0.2651	-0.2945	-0.3135	-0.3075	-0.4151	-0.1139
Post Monsoon rainfall	0.2165	0.087	0.208	0.197	0.1023	-0.2544
Over all rainfall	-0.0264	-0.0174	-0.0292	-0.0272	-0.0223	0.0172
Winter rainfall	0.0286	0.0581	0.0236	0.0276	0.0741	0.0455
GCF in Agriculture	-0.4774	-0.3746	-0.4655	-0.5208	-0.3509	0.319
Rice	0.0777	0.0696	0.0814	0.1066	0.1353	0.0349
Wheat	-0.1964	-0.2308	-0.2043	-0.2509	-0.3625	-0.1611
Total stock of food	0.5202	0.4715	0.4827	0.5368	0.636	-0.0486
Agricultural imports	-0.0172	-0.0151	-0.0172	-0.0177	-0.0137	0.0107
Seed	-0.6904	-0.5695	-0.621	-0.652	-0.4892	0.5353
N	-0.0928	-0.081	-0.092	-0.0952	-0.0684	0.0652
P	-0.8664	-0.7969	-0.8824	-0.8969	-0.6948	0.5057
K	0.3703	0.3248	0.3623	0.367	0.2764	-0.2567
Pesticides	0.3206	0.3683	0.3531	0.382	0.3794	0.0219
Marine Fish	-0.0225	-0.0149	-0.0212	-0.0245	-0.0157	0.0209

Factors	Co-operation	Food storage	Forestry	Fishery	Diary development	Monsoon Season ainfall	Post Monsoon rainf	Over all rainfall	Winter rainfall	GCF in Agriculture
Crop Husbandry	-0.2599	0.4608	-0.061	-0.0162	0.4292	-0.2549	-0.2735	-0.3318	0.0755	0.4198
Animal Husbandry	0.0131	-0.0821	-0.0286	-0.0351	-0.0991	0.059	0.0229	0.0456	-0.0319	-0.0686
Plantation	-0.4906	0.9544	0.0068	-0.0071	0.8593	-0.6496	-0.5662	-0.7889	0.1343	0.882
Agriculture Research	0.8475	-1.5809	-0.0086	0.0078	-1.3373	0.9765	0.8218	1.126	-0.2399	-1.5124
Other Agricultural Programmes	0.0031	-0.0634	-0.0357	-0.0299	-0.0954	0.0761	0.0246	0.0535	-0.0373	-0.0588
Soil and water conservation	-0.0937	0.0704	-0.0892	-0.0556	0.0048	0.0221	-0.065	-0.0437	-0.0242	0.0567
Co-operation	-0.4117	0.2527	-0.2796	-0.298	0.0153	0.0205	-0.296	-0.2243	-0.1694	0.3105
Food storage	-0.7873	1.2826	-0.3251	-0.0261	0.7678	-0.4261	-0.5909	-0.6789	0.2918	1.0828
Forestry	0.186	-0.0694	0.2738	0.1833	0.0702	-0.1162	0.1622	0.0528	0.0229	-0.0478
Fishery	0.2427	-0.0068	0.2245	0.3353	0.0922	-0.043	0.2429	0.1485	0.1603	-0.111
Diary development	0.0028	-0.0446	-0.0191	-0.0205	-0.0744	0.0484	0.0245	0.0389	-0.0303	-0.0396
Monsoon Season rainfall	-0.0281	-0.1881	-0.2402	-0.0725	-0.368	0.5662	0.1988	0.4178	-0.2306	-0.2619
Post Monsoon rainfall	-0.3099	0.1986	-0.2554	-0.3122	0.1417	-0.1513	-0.431	-0.3682	0.0026	0.2802
Over all rainfall	0.0236	-0.023	0.0084	0.0192	-0.0227	0.032	0.037	0.0434	-0.0037	-0.0308
Winter rainfall	0.085	0.047	0.0173	0.0987	0.084	-0.0841	-0.0013	-0.0175	0.2065	-0.0123
GCF in Agriculture	0.467	-0.5227	0.108	0.205	-0.3296	0.2864	0.4025	0.4404	0.0368	-0.6191
Rice	-0.0253	0.056	0.1016	-0.0095	0.0532	-0.1877	-0.0059	-0.1078	-0.0005	0.1045
Wheat	-0.0342	-0.1057	-0.3005	-0.0606	-0.2177	0.4373	0.0013	0.2205	-0.0596	-0.2111
Total stock of food	-0.1524	0.3385	0.226	0.0233	0.4503	-0.6451	-0.2111	-0.4846	0.0783	0.4558
Agricultural imports	0.0098	-0.0165	0.002	0.0002	-0.0113	0.0087	0.008	0.011	-0.0021	-0.0148
Seed	0.4484	-0.6579	0.2633	0.0845	-0.452	0.1646	0.3601	0.3561	-0.0789	-0.5429
N	0.0593	-0.0944	0.0198	0.0054	-0.0593	0.0338	0.044	0.0536	-0.0088	-0.0817
P	0.4498	-0.8344	0.0623	-0.0546	-0.5991	0.4181	0.3822	0.5277	-0.1325	-0.7389
K	-0.2158	0.3587	-0.0842	-0.0082	0.2548	-0.1325	-0.1823	-0.2148	0.0488	0.3005
Pesticides	-0.0613	0.2811	0.2066	0.0768	0.2966	-0.3337	-0.0813	-0.2254	0.0862	0.3236
Marine Fish	0.0241	-0.0277	0.0102	0.0107	-0.0109	0.0132	0.016	0.0199	-0.001	-0.0271

Factors	Rice	Wheat	Total stock	Agricultural imports	Seed	N	P	K	Pesticides	Marine fish	Inland fish
Crop Husbandry	0.1456	0.1868	0.3401	0.5118	0.5143	0.5065	0.5093	0.5219	-0.3799	0.3565	0.5193
Animal Husbandry	-0.0272	-0.0457	-0.0642	-0.0937	-0.0883	-0.0921	-0.0975	-0.0953	0.0909	-0.049	-0.098
Plantation	0.3287	0.4186	0.6801	1.1029	0.9967	1.082	1.1178	1.1004	-0.9016	0.7244	1.1103
Agriculture Research	-0.6594	-0.788	-1.1591	-1.7406	-1.6039	-1.7175	-1.7412	-1.708	1.4951	-1.283	-1.7835
Other Agricultural Programmes	-0.0483	-0.0657	-0.0793	-0.0781	-0.0695	-0.0712	-0.0779	-0.0743	0.0857	-0.0474	-0.0834
Soil and water conservation	-0.0132	-0.031	0.0064	0.0644	0.0806	0.0719	0.0601	0.0731	0.0053	0.0669	0.0567
Co-operation	0.0358	-0.0246	0.0753	0.2207	0.2526	0.2449	0.1999	0.23	-0.0549	0.2888	0.2186
Food storage	0.2472	0.2368	0.5214	1.157	1.1545	1.2143	1.1555	1.1908	-0.7849	1.0339	1.1616
Forestry	0.0957	0.1437	0.0743	-0.0301	-0.0986	-0.0544	-0.0184	-0.0597	-0.1231	-0.0812	-0.0146
Fishery	-0.0109	0.0355	0.0094	-0.0042	-0.0387	-0.0183	0.0198	-0.0071	-0.0561	-0.1042	-0.0134
Diary development	-0.0136	-0.0283	-0.0403	-0.0459	-0.046	-0.0443	-0.0482	-0.0491	0.0481	-0.0235	-0.0509
Monsoon Season rainfall	-0.3657	-0.4325	-0.4386	-0.2685	-0.1275	-0.1919	-0.2556	-0.1942	0.4113	-0.2175	-0.292
Post Monsoon rainfall	0.0088	0.001	0.1092	0.1877	0.2123	0.1902	0.1779	0.2034	-0.0763	0.2007	0.1968
Over all rainfall	-0.0161	-0.0167	-0.0252	-0.0261	-0.0211	-0.0233	-0.0247	-0.0241	0.0213	-0.0251	-0.0269
Winter rainfall	-0.0004	0.0215	0.0194	0.0237	0.0223	0.0183	0.0295	0.0261	-0.0388	0.0057	0.0236
GCF in Agriculture	-0.2225	-0.2284	-0.3389	-0.5023	-0.4599	-0.5072	-0.494	-0.4816	0.4361	-0.4881	-0.5325
Rice	0.2907	0.2776	0.2459	0.1115	0.0461	0.075	0.0765	0.0492	-0.1828	0.1775	0.121
Wheat	-0.5466	-0.5724	-0.5084	-0.2273	-0.0919	-0.1492	-0.1769	-0.1116	0.4279	-0.2798	-0.26
Total stock of food	0.7045	0.7396	0.8327	0.5387	0.3895	0.4154	0.4711	0.4018	-0.604	0.4977	0.5521
Agricultural imports	-0.007	-0.0072	-0.0118	-0.0183	-0.0168	-0.0178	-0.018	-0.0177	0.0136	-0.0142	-0.018
Seed	-0.116	-0.1174	-0.3419	-0.6708	-0.7309	-0.6947	-0.6571	-0.706	0.3831	-0.5334	-0.6649
N	-0.0257	-0.026	-0.0497	-0.0974	-0.0948	-0.0997	-0.0967	-0.0983	0.0684	-0.0779	-0.0969
P	-0.2438	-0.2862	-0.524	-0.9122	-0.8325	-0.8986	-0.9261	-0.9012	0.6891	-0.6296	-0.8975
K	0.0654	0.0753	0.1864	0.3739	0.3731	0.3809	0.3759	0.3863	-0.244	0.2718	0.3686
Pesticides	0.289	0.3434	0.3332	0.3425	0.2408	0.3151	0.3418	0.2902	-0.4594	0.2618	0.3736
Marine Fish	-0.021	-0.0168	-0.0206	-0.0267	-0.0251	-0.0269	-0.0234	-0.0242	0.0196	-0.0344	-0.0271

Factors	Total	Area	Production	Yield	Agricultural export	Cattle	Buffalo	Total Bovines	Sheep	Goats	Poultry
Crop Husbandry	0.5072	-0.2383	0.4016	0.4459	0.5057	-0.4746	0.5173	-0.5349	0.4789	0.3949	0.5301
Animal Husbandry	-0.0937	0.0446	-0.0774	-0.0858	-0.0869	0.0868	-0.0989	0.0976	-0.096	-0.0857	-0.0987
Plantation	1.0833	-0.588	0.8475	0.9605	1.0417	-1.0718	1.117	-1.12	1.0675	0.9291	1.1251
Agriculture Research	-1.7608	0.8754	-1.4695	-1.6295	-1.6423	1.6884	-1.7877	1.7656	-1.7338	-1.5456	-1.7854
Other Agricultural Programmes	-0.0812	0.0588	-0.0553	-0.0673	-0.0694	0.0729	-0.0861	0.0822	-0.0862	-0.0807	-0.0843
Soil and water conservation	0.057	-0.0067	0.0487	0.0491	0.0797	-0.059	0.0512	-0.0642	0.0367	0.0144	0.0588
Co-operation	0.2314	-0.0869	0.2014	0.2142	0.2501	-0.2438	0.2083	-0.231	0.1777	0.1241	0.2223
Food storage	1.1651	-0.5978	0.9786	1.087	1.1697	-1.2032	1.1355	-1.1395	1.084	0.9412	1.1444
Forestry	-0.0189	-0.0636	-0.038	-0.0225	-0.0779	0.0253	-0.0031	0.0443	0.0363	0.0877	-0.0263
Fishery	-0.0278	-0.0109	-0.0373	-0.0324	-0.0301	0.0323	-0.0152	0.0344	0.0039	0.0296	-0.0261
Diary development	-0.0488	0.0461	-0.0261	-0.0359	-0.0424	0.0489	-0.053	0.0524	-0.0513	-0.0457	-0.053
Monsoon Season rainfall	-0.3014	0.4598	-0.1047	-0.2035	-0.1717	0.3098	-0.3252	0.2698	-0.3643	-0.3933	-0.2959
Post Monsoon rainfall	0.2044	-0.1737	0.1269	0.1606	0.1923	-0.2334	0.2056	-0.2383	0.1658	0.1004	0.2252
Over all rainfall	-0.0278	0.0329	-0.0124	-0.0193	-0.0231	0.0311	-0.0285	0.0284	-0.0274	-0.0241	-0.0286
Winter rainfall	0.0223	-0.0405	0.0144	0.0231	0.0151	-0.0272	0.0269	-0.0253	0.0274	0.0262	0.0262
GCF in Agriculture	-0.5453	0.3303	-0.4582	-0.5174	-0.4637	0.5545	-0.5366	0.5204	-0.5295	-0.4844	-0.5306
Rice	0.137	-0.1464	0.081	0.111	0.0835	-0.1019	0.1288	-0.088	0.162	0.1968	0.1065
Wheat	-0.2818	0.3079	-0.1685	-0.2318	-0.1488	0.2094	-0.2832	0.201	-0.3493	-0.4169	-0.2384
Total stock of food	0.5687	-0.4942	0.3352	0.4359	0.4423	-0.4531	0.574	-0.5179	0.6031	0.6037	0.5455
Agricultural imports	-0.0178	0.0082	-0.0148	-0.0163	-0.0175	0.0169	-0.0178	0.0178	-0.017	-0.0148	-0.0179
Seed	-0.6539	0.2071	-0.5641	-0.5978	-0.7112	0.6107	-0.6451	0.6895	-0.5759	-0.4434	-0.6738
N	-0.096	0.0379	-0.084	-0.0905	-0.0974	0.0936	-0.0949	0.0961	-0.0898	-0.0769	-0.0961
P	-0.8788	0.3826	-0.7533	-0.8209	-0.8607	0.8532	-0.8876	0.8961	-0.8424	-0.7249	-0.8974
K	0.3607	-0.1487	0.3017	0.3282	0.3761	-0.3532	0.3613	-0.3755	0.3327	0.2716	0.3714
Pesticides	0.3758	-0.2329	0.3316	0.3745	0.2706	-0.3483	0.3879	-0.3357	0.4211	0.4387	0.3607
Marine Fish	-0.0288	0.0177	-0.0227	-0.026	-0.0277	0.028	-0.0266	0.025	-0.0271	-0.0259	-0.0259

Factors	Milk	Eggs	Procurement	Food subsidy	Fertilizer (Total)	Electricity subsid	Irrigation	subsidy
Crop Husbandry	0.5206	0.5275	-0.1912	0.1537	0.5284	0.5112	0.4886	0.5172
Animal Husbandry	-0.0984	-0.096	0.0469	-0.0345	-0.0997	-0.0858	-0.0954	-0.0878
Plantation	1.1217	1.1228	-0.5362	0.3535	1.1261	1.0393	1.1037	1.0448
Agriculture Research	-1.7875	-1.7697	0.8845	-0.665	-1.7748	-1.6282	-1.7489	-1.6407
Other Agricultural Programmes	-0.0838	-0.0803	0.0612	-0.0416	-0.0814	-0.0677	-0.0822	-0.0672
Soil and water conservation	0.0565	0.0653	0.0214	0.0032	0.0626	0.0827	0.0471	0.0827
Co-operation	0.2174	0.24	-0.0238	-0.0216	0.2163	0.2595	0.204	0.273
Food storage	1.1648	1.168	-0.5368	0.4932	1.1819	1.1309	1.1428	1.156
Forestry	-0.0154	-0.0446	-0.1207	0.0787	-0.0339	-0.0992	0.0143	-0.0963
Fishery	-0.0154	-0.0414	-0.0343	0.1512	-0.0083	-0.057	-0.0073	-0.0541
Diary development	-0.0521	-0.051	0.0402	-0.0106	-0.0521	-0.0416	-0.0517	-0.0451
Monsoon Season rainfall	-0.3011	-0.2686	0.4992	-0.2617	-0.2547	-0.1535	-0.3356	-0.1424
Post Monsoon rainfall	0.2067	0.2362	-0.1067	-0.1086	0.2064	0.226	0.1903	0.2396
Over all rainfall	-0.0279	-0.0287	0.0276	-0.0052	-0.0259	-0.0238	-0.0288	-0.0243
Winter rainfall	0.0269	0.0227	-0.0629	0.0638	0.032	0.0152	0.0222	0.0071
GCF in Agriculture	-0.5333	-0.5288	0.3344	-0.1365	-0.5108	-0.4605	-0.5382	-0.4905
Rice	0.1162	0.0958	-0.1977	0.202	0.0815	0.064	0.1307	0.0351
Wheat	-0.2531	-0.207	0.4234	-0.3619	-0.1869	-0.1167	-0.2817	-0.0738
Total stock of food	0.5422	0.5005	-0.5236	0.5384	0.4747	0.4183	0.5304	0.3789
Agricultural imports	-0.0179	-0.0178	0.0076	-0.0091	-0.0179	-0.0173	-0.0172	-0.0171
Seed	-0.6629	-0.6868	0.1239	-0.1975	-0.6891	-0.7195	-0.6026	-0.7193
N	-0.0968	-0.0975	0.0343	-0.0381	-0.0982	-0.0961	-0.0933	-0.096
P	-0.8978	-0.8912	0.3551	-0.4029	-0.9091	-0.8523	-0.8648	-0.8634
K	0.3696	0.3758	-0.1127	0.1266	0.3806	0.375	0.3501	0.3792
Pesticides	0.3728	0.3417	-0.3355	0.2238	0.343	0.2547	0.3938	0.2485
Marine Fish	-0.0268	-0.0267	0.0183	-0.0182	-0.0252	-0.0261	-0.0271	-0.0242

Factors	Crop Husbandry	Animal Husbandry	Plantation	Agriculture Research	Other Agricultural Programmes	Soil and Water conservation	Co-operation	Food Storage
Inland	-0.1206	-0.1093	-0.1196	-0.1254	-0.1016	0.0651	0.0671	-0.1145
Total	-0.2275	-0.2019	-0.2255	-0.2392	-0.1911	0.1266	0.1373	-0.2219
Area	0.1524	0.1371	0.1746	0.1696	0.1972	-0.0211	-0.0735	0.1623
Production	0.3819	0.3536	0.374	0.4231	0.2758	-0.229	-0.2533	0.3949
Yield	-0.2703	-0.2499	-0.2703	-0.2992	-0.2139	0.1472	0.1717	-0.2798
Agricultural exports	-0.4118	-0.3397	-0.3937	-0.405	-0.2966	0.321	0.2694	-0.4043
Cattle	-0.3579	-0.3144	-0.3752	-0.3856	-0.2884	0.2201	0.2432	-0.3852
Buffalo	0.6271	0.5758	0.6284	0.6562	0.5473	-0.3071	-0.3339	0.5843
Total Bovines	-0.9481	-0.831	-0.9213	-0.9476	-0.764	0.5632	0.5416	-0.8574
Sheep	-0.0247	-0.0238	-0.0255	-0.0271	-0.0233	0.0094	0.0121	-0.0237
Goats	0.3361	0.3504	0.3669	0.3983	0.3603	-0.0605	-0.1397	0.34
Poultry	1.2007	1.074	1.1826	1.2245	1.0022	-0.6593	-0.6659	1.1003
Milk	-0.1775	-0.1611	-0.1775	-0.1845	-0.1499	0.0953	0.098	-0.1685
Eggs	0.3726	0.3255	0.3681	0.3785	0.2974	-0.2284	-0.2242	0.3502
Procurement	-0.2205	-0.2596	-0.2871	-0.3089	-0.3701	-0.1219	0.0363	-0.2628
Food subsidy	-0.0571	-0.0616	-0.061	-0.0748	-0.0811	0.0059	-0.0106	-0.0778
Fertilizer (Total)	-0.361	-0.3272	-0.357	-0.3671	-0.2918	0.2114	0.1954	-0.3427
Electricity subsidy	-0.2044	-0.1648	-0.1929	-0.1971	-0.1419	0.1636	0.1372	-0.192
Irrigation	-0.0107	-0.01	-0.0112	-0.0116	-0.0094	0.0051	0.0059	-0.0106
Subsidy	-0.5012	-0.4086	-0.4699	-0.4814	-0.3418	0.3967	0.3499	-0.4755
Household food sec	-0.9756	-0.9894	-0.8628	-0.7992	-0.9566	0.5664	0.5563	-0.9014
Partial R²	-0.5311	1.7788	0.0978	0.0829	-1.1222	-0.0623	-0.229	-1.1561

Factors	Forestry	Fishery	Diary development	Monsoon Season rainfall	Post Monsoon rainf	Over all rainfall	Winter rainfall	GCF in Agriculture	Rice	Wheat	Total stock
Inland fish	0.0067	0.0051	-0.0865	0.0652	0.0577	0.0784	-0.0144	-0.1087	-0.0526	-0.0574	-0.0838
Total fish	0.0169	0.0202	-0.16	0.13	0.1158	0.1566	-0.0264	-0.2151	-0.1151	-0.1202	-0.1668
Area	0.0809	0.0113	0.2158	-0.2828	-0.1403	-0.2641	0.0682	0.1858	0.1754	0.1873	0.2067
Production	-0.0718	-0.0576	0.1814	-0.0957	-0.1524	-0.1476	0.0362	0.3831	0.1442	0.1524	0.2084
Yield	0.0271	0.0319	-0.1591	0.1186	0.123	0.1467	-0.037	-0.2759	-0.126	-0.1337	-0.1728
Agricultural exports	0.1262	0.0398	-0.2528	0.1344	0.1978	0.2357	-0.0323	-0.3321	-0.1273	-0.1152	-0.2355
Cattle	0.038	0.0395	-0.2696	0.2247	0.2224	0.2941	-0.054	-0.3678	-0.1439	-0.1502	-0.2234
Buffalo	-0.0074	-0.0299	0.4698	-0.3791	-0.3148	-0.434	0.0861	0.5721	0.2925	0.3266	0.4549
Total Bovines	0.1563	0.099	-0.6796	0.4598	0.5336	0.6319	-0.1184	-0.8111	-0.2922	-0.3388	-0.6002
Sheep	-0.0037	-0.0003	-0.0194	0.0181	0.0108	0.0178	-0.0037	-0.024	-0.0156	-0.0171	-0.0203
Goats	0.1485	0.0409	0.2843	-0.3219	-0.1079	-0.2576	0.0587	0.3625	0.3137	0.3374	0.3359
Poultry	-0.1186	-0.096	0.8775	-0.6444	-0.6444	-0.8138	0.1564	1.0568	0.4519	0.5136	0.8078
Milk	0.0105	0.0085	-0.1299	0.0987	0.089	0.1194	-0.0242	-0.1599	-0.0742	-0.082	-0.1208
Eggs	-0.0627	-0.0475	0.2637	-0.1824	-0.2107	-0.2541	0.0423	0.3285	0.1268	0.1391	0.2311
Procurement	-0.2769	-0.0643	-0.3392	0.5536	0.1554	0.4002	-0.1914	-0.3392	-0.4272	-0.4646	-0.3949
Food subsidy	-0.0582	-0.0912	-0.0288	0.0935	-0.051	0.0245	-0.0626	-0.0446	-0.1407	-0.1279	-0.1308
Fertilizer (Total)	0.046	0.0092	-0.2605	0.1673	0.1781	0.2225	-0.0577	-0.3068	-0.1043	-0.1214	-0.212
Electricity subsidy	0.0789	0.037	-0.1216	0.059	0.1141	0.1194	-0.0161	-0.1619	-0.0479	-0.0444	-0.1094
Irrigation	-0.0006	0.0003	-0.0083	0.007	0.0052	0.0079	-0.0013	-0.0103	-0.0053	-0.0059	-0.0076
Subsidy	0.1857	0.0851	-0.3197	0.1327	0.2933	0.2954	-0.0182	-0.418	-0.0637	-0.068	-0.24
Household food sec	0.1249	0.0854	-0.6996	0.495	0.5191	0.649	-0.1162	-0.8493	-0.3578	-0.3973	-0.6415
Partial R²	0.0342	0.0286	0.0521	0.2803	-0.2237	0.0281	-0.024	0.5258	-0.104	0.2274	-0.5341

Factors	Agricultural imports	Seed	N	P	K	Pesticides	Marine	Inland	Total	Area	Production
Inland fish	-0.1244	-0.115	-0.1228	-0.1225	-0.1206	0.1028	-0.0996	-0.1264	-0.1258	0.0611	-0.1057
Total fish	-0.2383	-0.2185	-0.235	-0.2317	-0.2281	0.1998	-0.2045	-0.2432	-0.2442	0.1252	-0.2038
Area	0.1561	0.0987	0.1325	0.1439	0.1341	-0.1766	0.1797	0.1684	0.1785	-0.3483	0.0024
Production	0.421	0.3995	0.436	0.421	0.4043	-0.3736	0.3411	0.4331	0.4319	-0.0036	0.5176
Yield	-0.2951	-0.27	-0.2996	-0.2926	-0.2804	0.2691	-0.2495	-0.305	-0.3062	0.0756	-0.3218
Agricultural exports	-0.426	-0.4314	-0.4332	-0.412	-0.4317	0.2612	-0.3571	-0.4171	-0.414	0.167	-0.3408
Cattle	-0.3811	-0.3431	-0.3853	-0.3783	-0.3754	0.3113	-0.3338	-0.3895	-0.3923	0.2604	-0.3003
Buffalo	0.6419	0.5825	0.6285	0.6326	0.6174	-0.5572	0.5112	0.6578	0.6556	-0.3445	0.5417
Total Bovines	-0.9404	-0.9103	-0.9302	-0.9337	-0.9382	0.7051	-0.7012	-0.9474	-0.9344	0.4186	-0.7817
Sheep	-0.0261	-0.0221	-0.0253	-0.0255	-0.0242	0.0257	-0.0221	-0.0272	-0.0274	0.0164	-0.0223
Goats	0.3753	0.2811	0.3575	0.3627	0.3258	-0.4424	0.3484	0.4017	0.4107	-0.2914	0.3292
Poultry	1.2074	1.1367	1.1891	1.195	1.1856	-0.9681	0.9274	1.2256	1.2145	-0.5864	1.0102
Milk	-0.1822	-0.1683	-0.1802	-0.1799	-0.1775	0.1506	-0.1449	-0.1854	-0.1844	0.0935	-0.153
Eggs	0.3753	0.3614	0.3759	0.3701	0.3741	-0.286	0.2985	0.3803	0.3776	-0.1792	0.3139
Procurement	-0.262	-0.1065	-0.2162	-0.2408	-0.1832	0.4587	-0.3336	-0.3071	-0.3333	0.5514	-0.1246
Food Subsidy	-0.1008	-0.0547	-0.0773	-0.088	-0.0663	0.0986	-0.1068	-0.0877	-0.0925	0.0756	-0.0622
Fertilizer (Total)	-0.3648	-0.3506	-0.3662	-0.365	-0.3664	0.2776	-0.2723	-0.3673	-0.3619	0.1598	-0.308
Electricity subsidy	-0.206	-0.2143	-0.2097	-0.2003	-0.2113	0.1207	-0.165	-0.2016	-0.1991	0.0639	-0.1724
Irrigation	-0.0112	-0.0098	-0.0111	-0.0111	-0.0108	0.0102	-0.0094	-0.0116	-0.0116	0.0072	-0.0092
Subsidy	-0.4938	-0.5192	-0.5078	-0.4919	-0.5179	0.2854	-0.3706	-0.4868	-0.477	0.165	-0.4077
Household food security	-0.9824	-0.9366	-0.973	-0.9687	-0.9701	0.7624	-0.7665	-0.9937	-0.9851	0.468	-0.8161
Partial R²	0.0179	0.6846	0.097	0.8971	-0.3748	-0.3502	0.0264	0.1256	0.2406	-0.163	-0.4224

Factors	Yield	Agricultural exports	Cattle	Buffalo	Total Bovines	Sheep	Goats	Poultry	Milk	Eggs	Procurement
Inland fish	-0.1168	-0.1189	0.1199	-0.126	0.1241	-0.1225	-0.1096	-0.1256	-0.1262	-0.125	0.0618
Total fish	-0.2266	-0.228	0.2333	-0.2426	0.2365	-0.2382	-0.2165	-0.2405	-0.2427	-0.2398	0.1296
Area	0.0797	0.1312	-0.2209	0.1818	-0.1511	0.2034	0.219	0.1656	0.1755	0.1623	-0.3058
Production	0.5047	0.3978	-0.3785	0.4248	-0.4193	0.4121	0.3678	0.424	0.4266	0.4225	-0.1027
Yield	-0.3301	-0.276	0.2819	-0.3026	0.2929	-0.2991	-0.2746	-0.2988	-0.3025	-0.2973	0.1274
Agricultural exports	-0.3707	-0.4433	0.3943	-0.4057	0.4191	-0.376	-0.3105	-0.4156	-0.4158	-0.4243	0.1246
Cattle	-0.3507	-0.3652	0.4106	-0.3902	0.3775	-0.3859	-0.3542	-0.3853	-0.3932	-0.3897	0.2501
Buffalo	0.6051	0.604	-0.6272	0.66	-0.645	0.6465	0.5854	0.6553	0.6583	0.6495	-0.3562
Total Bovines	-0.8562	-0.9123	0.8872	-0.9431	0.965	-0.8827	-0.742	-0.9607	-0.9492	-0.9582	0.3722
Sheep	-0.0254	-0.0238	0.0264	-0.0275	0.0257	-0.0281	-0.027	-0.0266	-0.0272	-0.0262	0.0186
Goats	0.3854	0.3245	-0.3996	0.411	-0.3562	0.4456	0.4633	0.3825	0.401	0.3729	-0.3647
Poultry	1.1164	1.1559	-1.1572	1.2244	-1.2277	1.1698	1.0181	1.2332	1.2274	1.2266	-0.5626
Milk	-0.1701	-0.1741	0.1777	-0.1851	0.1825	-0.1799	-0.1606	-0.1847	-0.1856	-0.1841	0.0934
Eggs	0.3464	0.3681	-0.365	0.3785	-0.3819	0.3594	0.3095	0.3825	0.3815	0.3846	-0.1657
Procurement	-0.2425	-0.1764	0.3826	-0.339	0.2422	-0.4165	-0.4944	-0.2865	-0.3162	-0.2706	0.628
Food Subsidy	-0.0776	-0.0825	0.0758	-0.0852	0.066	-0.0999	-0.1133	-0.0749	-0.0835	-0.0676	0.0958
Fertilizer (Total)	-0.3364	-0.3556	0.3495	-0.3642	0.3684	-0.345	-0.2959	-0.3686	-0.3681	-0.3693	0.1489
Electricity subsidy	-0.1829	-0.2147	0.1863	-0.1964	0.2082	-0.177	-0.1388	-0.2041	-0.2013	-0.2083	0.043
Irrigation	-0.0106	-0.0105	0.0116	-0.0117	0.0111	-0.0117	-0.011	-0.0114	-0.0116	-0.0114	0.0075
Subsidy	-0.4351	-0.5095	0.4584	-0.4747	0.5079	-0.4233	-0.3251	-0.4961	-0.487	-0.5043	0.0972
Household food security	-0.9009	-0.9535	0.9393	-0.9894	0.996	-0.9416	-0.8142	-0.9987	-0.9947	-0.9975	0.4362
Partial R²	0.2974	0.4227	0.3857	-0.653	0.9611	0.0264	-0.3772	-1.2315	0.1846	-0.3836	0.2739

	Food subsidy	Fertilizer (Total)	Electricity subsid	Irrigation	subsidy
Inland fish	-0.0548	-0.1248	-0.1171	-0.1232	-0.1166
Total fish	-0.1117	-0.2376	-0.2233	-0.2387	-0.2208
Area	0.1302	0.1496	0.1022	0.2103	0.1089
Production	0.1592	0.4287	0.41	0.4006	0.4
Yield	-0.1266	-0.2986	-0.2773	-0.2936	-0.2722
Agricultural exports	-0.1807	-0.4239	-0.4373	-0.392	-0.4281
Cattle	-0.1537	-0.3859	-0.3513	-0.4018	-0.3568
Buffalo	0.278	0.6464	0.5954	0.6475	0.5938
Total Bovines	-0.3147	-0.9559	-0.9228	-0.8998	-0.9289
Sheep	-0.0139	-0.026	-0.0228	-0.0277	-0.0225
Goats	0.2595	0.3686	0.2953	0.4296	0.2855
Poultry	0.4563	1.2223	1.1564	1.183	1.1594
Milk	-0.0766	-0.1837	-0.1716	-0.1818	-0.1713
Eggs	0.1285	0.3819	0.368	0.3683	0.3676
Procurement	-0.2972	-0.2515	-0.1241	-0.3952	-0.1157
Food Subsidy	**-0.2024**	-0.0728	-0.063	-0.0861	-0.0459
Fertilizer (Total)	-0.1338	**-0.3719**	-0.3544	-0.3539	-0.3561
Electricity subsidy	-0.0677	-0.2075	**-0.2177**	-0.1847	-0.2138
Irrigation	-0.0051	-0.0113	-0.0101	**-0.0119**	-0.0101
Subsidy	-0.1197	-0.5052	-0.5182	-0.4485	**-0.5276**
Household food security	-0.3716	-0.9935	-0.9518	-0.9566	-0.9518
Partial R²	0.0752	0.3695	0.2072	0.0114	0.2072

based on the PDS, but involving effective implementation of anti-poverty programmes, controlling inflation, and improving health facilities, are required to solve the food security problem in India.

In this study, it was concluded that Annual central allocation on plantation (1.1731), expenditure incurred for food storage (1.2826) and poultry production (1.2332) were the factors that had significant direct affect and annual central allocation to agricultural research and education (-1.7980) had direct negative effect on household food security of India.

Suggestions

It can be summarized that careful planning and judicious packaging of these components such as the expenditure on agriculture and allied sector, expenditure allocation of central government to various agricultural and allied sector activities, climate and stock component and storage component are the important components that were influencing the agricultural development in India. Annual central allocation on plantation, expenditure incurred for food storage and poultry production were the factors that had significant direct affect and annual central allocation to agricultural research and education had direct negative effect on household food security of India. A careful study of these components for their contribution and judicious packaging of these components in various agricultural development policies is very much needed for the sustainable agricultural development leading to the comprehensive food security of India. it is also evident that the central allocation to various activities of agricultural and allied sector, area and production of food grains, agricultural inputs, production of the allied sector, subsidies spent on the agriculture infrastructure, GCF in agriculture, rainfall, stock of food grains and expenditure on the storage and warehousing were the important sub components that might affect the sustainable agricultural development leading to the comprehensive food security of India.

Policy makers should carefully study, analyze and interpret the above components and sub components for their interrelationship as well as contribution towards sustainable agricultural development leading to the comprehensive food security of India.

More precisely they should thrive to enhance and sustain the allocations for gross capital formation and design policies for increasing the storage capacity necessary for the staple foods such as rice and wheat both in terms of quality and quantity. The path that was emerged was Sustained annual central allocations for plantations, investment for increasing food storage, for increasing poultry population along with increased allocations to agricultural research and education, efforts to increase the buffalo and total bovine population, better utilization of phosphoric fertilizer usage in particular and overall NPK fertilizers in general in various proportions depending on different macro- economic, agricultural, climatic and community specific contingent situations might lead to sustained food security situation in India. Finally, intensive efforts for breakthrough for substantial jump in the production of food grains are needed as per the emerged facts in the study.

References

Ciamarra, U. P and Otte, J (2010). Poultry, food security and poverty in India looking beyond the farm gate. *World's Poultry Science Journal*, 66 (2): 309-320.

Carlo del Ninno, Paul, A. Dorosh and Subbarao, K (2007). Food aid, domestic policy and food security: Contrasting experiences from South Asia and sub-Saharan Africa. *Food Policy,* 32: 413-435.

Department of Agriculture and co operation, Government of India. *Statistics* http:// www.agricoop.nic.in.

Lenka, D. and Misra, B. (1973) Path coefficient analysis of yield in rice varieties. *Indian J. Agric. Sci.,* 43: 376 – 379.

Wright, S. 1921. Correlation and causation. *Journal of Agricultural Research.* 20: 557-585.

Nabarro, D., Menon, P., Ruel, M., Yosef, S. (2012) SUN : A global movement to accelerate reduction of maternal and child under nutrition (Brief 9) In : *Scaling up in Agriculture, Rural Development, and Nutrition edited by Johannes F.Linn.* International Food Policy Research Institute. Washington, DC.

Sen, A.K. (1981) Poverty and Famines: An Essay on Entitlements and Deprivation. Oxford. Clarendon Press.

Dev, S. M. (2007) Inclusive growth in Andhra Pradesh: Challenges in Agriculture, Poverty, Social Sector and Regional Disparities. *Working paper No. 71 of the Centre for Economic and Social Studies*, Hyderabad.

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