



Compendium on **AGRICULTURAL EXTENSION**



Kalyan Ghadei

About the Author



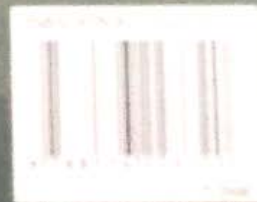
Dr. Kalyan Ghadei, Ph.D in Extension Education, B. Mus. (ABGMM), C.C. (Polski) has a brilliant academic career. He is a recipient of UGC Raman fellowship, Post doctoral fellow from Virginia Tech, USA. His research interests include studies related to gender issues in agriculture, environment, communication and NGOs.

He is serving as an Assistant Professor in the Department of Extension Education at Banaras Hindu University, Varanasi, India. He is a member in many academic bodies and published about 20 papers in journals and conferences. He has also authored books on Women Empowerment, Panchayati Raj and Role of NGOs in extension services.

xii+401p., figs., tabs., referece., 25cm
ISBN 978-81-7622-372-0
₹ 2500/-



BIOTECH BOOKS
4762-63/23, Ansari Road,
Darya Ganj, New Delhi-110002
Ph.: 011- 23262132
e-mail : biotechbooks@yahoo.co.in



Compendium on AGRICULTURAL EXTENSION

Editor
Kalyan Ghadei


BIOTECH
2016
BIOTECH BOOKS

Associate Editors

Dr. V. Kamalvanshi

Dr. Santeshwari

Dr. Dheeraj Mishra

Mr. Sravan Kumar Tamminana

Ms. Neha Upreti

Mr. Sundharavadivu. S

The views expressed in this Compendium are those of the authors and do not necessarily reflect the views of the Organizers/Publisher/Printer

© 2016

ISBN: 978-81-7622-372-0

All rights reserved. Including the right to translate or to reproduce this book or parts thereof except for brief quotations in critical reviews.

Published by : **BIOTECH BOOKS**
4762-63/23, Ansari Road,
Darya Ganj, New Delhi - 110 002
Phone: +91-011-23262132
E-mail: biotechbooks@yahoo.co.in

Laser Typesetting : **Sushil Kumar**

Digitally Printed at : **Replika Press Pvt. Ltd**
Delhi - 110 052

PRINTED IN INDIA

THE BOOK

This Compendium on Agricultural Extension is unique of its kind. It has always been a subject of meticulous exercise to anatomize the papers and organize them in good writing principles. The volume is a compilation of research and review papers rich in sense that they had been reviewed by different experts of agricultural extension. The book is distinguished as it contains papers of three important areas: agricultural extension education, agricultural extension research and agricultural extension services and also ponder on appropriate policy issues as felt by different experts.

Women are the key element of our development society and agriculture. The book has a magnificent anthology of **research papers on women and agricultural extension**. Information Technology owing to its application and reach out to the farmers is an emergent phenomenon in field of agricultural extension. So, number of research papers related to **ICT extension services** have been incorporated in this manuscript. Some imperative works related to **agricultural innovation and adoption of technology** have been placed in this book which can give a new sight to the extension scientists and readers in agricultural sciences. There has been extensive transformation and diversity in field of agricultural extension throughout the globe. The teaching methods and approaches to extension have resulted in manifold changes. In this context, suitable policy implications are required for reaching out farmers effectively. The volume of this compendium is also bestowed with **papers on policy issues on agricultural extension** that may serve planners and policy makers of agricultural extension services.

Contents

<i>Preface</i>	vii
1. Demographic Study of Agrarian Society for Sustainable Development in India: New Dimension in Research and Extension for Rural Development <i>Sarda Prasad and Bhaswati Das</i>	1
2. Decentralized Agricultural Extension Service Provision: Policy Initiatives of Extension Approach to Local People <i>Mahesh Jaishi and Lochana Shahi</i>	17
3. Restructuring Agricultural Extension Education in India: A Future Perspective <i>Arpit Huria and V.L.V. Kameswari</i>	33
4. Recent Trends in Extension Education <i>Vinita Pandey, Ritu Mittal and Saroj</i>	39
5. Entrepreneurship Development among Extension Students <i>Renu Gangwar and S.K. Kashyap</i>	55
6. Importance of Audio-Visual Aids in Extension Education for Effective Teaching <i>Sabita, Vidhu Dwivedi and J.S. Tripathi</i>	61
7. The Role of ICTs to Make Teaching-Learning Effective in Agricultural Extension <i>Kirti, Dipak De and Pankaj Kumar Mandal</i>	69
8. Entrepreneurship and Skill Development among Extension Students <i>Jitendra Pal Ghatawal and Pramod Prajapati</i>	77

have been used for the study. Both disciplines are studying causes and consequences of changes in rural labour market due to changes in demographic events (Fertility, Mortality and migration). For example, migration is the third pillar of demography whereas supply and demand of active agriculture labour is the interest of extension researcher. Experts of both disciplines have research interest on demographic transition (changes in births and deaths) and demographic dividend (youth/working age population). Thus we have developed a course curriculum for the study of agrarian society for sustainable development of rural areas. In India, demographic changes have been observed in rural areas due to changes in vital events, social, economic, political and environmental phenomenon.

Keywords: Vital events, education, migration, urbanization, labour market, gender in mainstreaming, socio-economic, sustainable development

Introduction

"Any research in agriculture sector without knowing of demographic trends in any geographic area is like letting loose an arrow in the darkness".

Demography and agriculture has closely linked and both are compatible to each other in all its components. Malthus (1798) was the first proponent of demography and agriculture and he has tried to established relationship between growth rate of population and agriculture. In his essay on "Principle of Population" he expressed connection with population growth and well-beings. He propounded that nature of population growth is in exponential rate whereas growth of agriculture is in rate of arithmetic nature. His concept was the size and growth of the population depends on the food supply and practices of agriculture. Another thinker Boserup (1965) explained the relationship among population, environment and technology. Unlike Malthus, theory of agricultural practices depends on the size of the population. Malthus and Boserup have explained concepts of population and agriculture contradicts each other. According to Malthus population will be dying due to shortage of food grains whereas Boserup focus of new technology in agriculture if needed for increasing food supply. Thus Boserup idea was based on "need is the mother of invention". Boserup argued that in case population pressure will be high for food supply, people will be searching new methods or ways for increasing the production of food by increasing workforce, mechanization in agriculture and fertilizers. She also proposed relationship between arable and fallow land with population density. Marquette (1997) has mentioned that Malthus's concept was "invention-pull" population growth whereas Boserup's idea was "invention-push" agriculture growth. Boserup argued that if population density increases the land use increases proportional and cropping patterns changes accordingly. Marx and Durkheim also proposed population growth and labour division for more efficient production. Cain (1985) has studied "on

1

Demographic Study of Agrarian Society for Sustainable Development in India: New Dimension in Research and Extension for Rural Development

Sarda Prasad¹ and Bhaswati Das²

¹Post Doctoral Fellow, ²Professor, Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi-67
Email: sardaprasadk@gmail.com

ABSTRACT

Malthus was the first thinker who has linked population and agriculture growth rate. Demography (or Population Studies) and Extension Education deal the scientific study of the population (age, sex, class, residence) in a particular geographic region/area. The aims of both social sciences discipline are development of family (Individual) and its components. Extension Education 'helps people to help themselves' by changing their positive behaviour (knowledge, attitude and skills/practice-KAS/P) whereas demographers keen to know the nature and pattern (including knowledge, attitude and practice/skill (KAP/S) of family planning) of vital events occurs in society in both rural and urban areas. Components of both discipline are Knowledge (or Awareness), Attitude and Skill (Practice) about the development techniques. Objective of the paper is- to established relationship between demography and extension education for the study of agrarian society. That would be new research trends for the study of farming (and rural) communities. Census, NSSO, NFHS and other relevant sources of data

the relationship between landholding and fertility" and stated that fertility is influenced by land holding and land holding is influenced by family size. He/She has given two hypotheses that are related to landholding and fertility i.e., land security hypothesis and land-labour demand hypothesis. A response to Cain, Stokes *et al.*, (1986) stated that "the fertility behaviour of landowners, tenant farmers, communal landholders and landless labourers is influenced by their respective rights in land is supported by the emerging theoretical and empirical evidence".

Importance of labour in agriculture that is main input cannot be ignored. Many researches find out that major factors of change in labour market are – biological, socio-economic and political. Fertility rate (high or low) and mortality rate (high or low) are related to biological factors whereas migration and structural policy and government schemes are socio-economic and political factors. Tilakratne and Somaratne (2002) listed eight reasons for labour scarcity as perceived by farmers. These are attitudes of younger generations, seasonality of operations, existence of government seed farm, establishment of garments factories, out-migration, provision of liquor, joining security forces and small family size. Among these migration and family size is the main interest of demographers whereas low supply of agriculture labour is the main focus of agriculture scientists. Prasad (2013) also find out the main reasons of labour shortage in agriculture such as farmers and youths are not interested in farming, rural out-migration and urbanization, MGNREGA, and socio-political or institutional influences. According to duration of engagement in work Census of India categorized two types of agricultural worker (A person who works on another person's land for wages in money or kind or share is regarded as an agricultural labourer) i.e., main agricultural worker (those are engaged more than 183 days in agricultural work during 365 days) and marginal agricultural worker (those are engaged less than 183 days in agricultural work during 365 days). Census has also collected information of cultivators by sex and residence. The cultivator, who is engaged in cultivation of land owned or held from Government or held from private persons or institutions for payment in money, kind or share. Role of human labour should not be underestimated. Box 1 shows the relationship between labour and agricultural operations.

Box 1: Field operation that needs human labour (by sex) and machine labours

1	Manuring/composting (10-20 tonnes/ha)	9	Disease management
	-Loading and deloading		Mechanical
	-Spreading		Chemical
2	Field preparation	10	Harvesting
	By plough		Manual
	by tractor		Harvester/Combine
3	Improved varieties and seed treatment	11	Threshing
4	Sowing/Transplanting		Manual
	Line sowing		Thresher
	Spreading		Bullock padding
	Transplanting	12	Cleaning of grain/Seed
	Tractor/Cultivator		Benower
5	Irrigation (If delayed, 5% yield reduced per day)		Hand cleaning
	Flooding	13	Packaging
	Check basin/bunding/furrow		In container
	Sprinkler/drip		in packet/bag
6	Weeding (2 to 4 @ 15 days interval)	14	Storing
	Manual		Storage/Dumping
	Mechanical		Bags
	Chemical		Containers
7	Fertilizer and quantity (A,B,C,D)	15	Marketing
	Basal application		Local market
	Folliar application/Spreading		Distance market
	Liquid application (With irrigation water)		National/Internal market
8	Insect pest control	12-15	Post harvest management
	Mechanical		Value addition
	Chemical		

Indian agriculture is labour intensive enterprises and it has tremendous opportunity for creating jobs for millions of hands. The above listed fields operations required labour according to its nature of operations. Some works are required skilled labour and some are light work or some works are not skilled and heavy jobs. For example, pre harvest crop can managed non skilled

and semi skilled labour but post harvest management required skilled and trained labours. Table 1 shows the labour requirement by crops and labour accessibility to the farmers. And most of the farmers have not accessed required number of agricultural labour due to various reasons.

Table 1: Labour demand and supply gap in Bundelkhand region, 2011

Crop	Agriculture Form*	Farmer Hired lab/ Ha (Av)	Labour Gap or Shortage
Paddy	149	54	95
Sorghum(Jowar)	56	41	15
Black gram(Urd)	76	37	39
Green Gram(Moong)	42	37	5
Red Gram(Arhar)	65	37	28
Sesum (Till)	89	21	68
Wheat	42	59	-17
Maize	151	na	na
Ground nut (moong falli)	168	na	na
Cotton	268	na	na
Sugarcane	502	na	na

*from Literatures, na- not available

Thomas (2012) analysed the net increase/decrease workers in India, and stated that agricultural workers increased 32.4 million during 1984 to 1993-94 that has declined by -1.8 million during 1993-94 to 2009-10. Table 2 shows demographic trends by sex. Male population in total has declined by -0.51% in which -0.17% in rural and -1.48 in urban areas. But female population share has increased almost similar trends in both residences during 2001 to 2011. If we look work participation rate by sex and residence, the total female work participation rate has declined in rural areas by -2.50 per cent but it has increased in urban areas by 32 per cent. Female main work participation rate has increased in both areas (Table 2). Number of cultivators has gone down in both areas but female work participation rate as agricultural workers have gone up that indicates feminization in agriculture. Structural changes in population in rural and urban areas are appearing. These changes may be due to demographic process mainly fertility and migration. One hand population share has decreased in rural areas, on the other hand urban population share has increased. Urban fertility is lower than rural fertility then main reason of urbanization in India is internal migration (rural to urban). Figure 1 clearly shows age-sex composition in rural and urban in 2011 that indicates demographic dividend

Table 2: Population and Work participation rate (%) in 2001 and 2011

Item	Total		Rural		Urban		% Changes during 2001 to 2011		
	2001	2011	2001	2011	2001	2011	Total	Rural	Urban
Total Population									
Male	51.7	51.5	51.4	51.3	52.6	51.8	-0.51	-0.17	-1.48
Female	48.3	48.5	48.6	48.7	47.4	48.2	0.54	0.18	1.65
Female									
Total worker	25.6	25.5	30.8	30.0	11.9	15.4	-0.44	-2.50	29.99
Main	14.7	15.2	16.6	16.7	9.4	11.9	3.58	0.22	26.14
Cultivator	5.1	3.9	6.9	5.5	0.3	0.3	-23.96	-20.50	-9.41
Agricultural Lab	4.5	5.3	5.9	7.2	0.7	0.9	16.74	21.90	20.02
Household	0.9	0.8	0.9	0.8	1.0	0.9	-13.79	-17.02	-8.62
Others	4.1	5.2	2.9	3.2	7.3	9.8	27.38	10.61	33.30
Male									
Total worker	51.7	53.3	52.1	53.0	50.6	53.8	3.06	1.77	6.26
Main	45.1	43.8	44.3	41.6	47.2	48.7	-2.86	-6.05	3.10
Cultivator	14.7	11.7	20.0	16.5	1.2	1.3	-20.32	-17.73	7.64
Agricultural Lab	7.7	8.9	10.3	12.1	1.3	1.8	14.76	17.76	40.02
Household	1.4	1.2	1.3	1.0	1.6	1.7	-14.24	-26.11	4.96
Others	21.3	22.0	12.7	12.1	43.0	43.8	3.56	-4.77	1.77
Total									
Total worker	39.1	39.8	41.7	41.8	32.3	35.3	1.76	0.19	9.47
Main	30.4	29.9	30.9	29.5	29.3	30.9	-1.61	-4.48	5.63
Cultivator	10.1	7.9	13.6	11.1	0.8	0.8	-21.41	-18.48	3.24
Agricultural Lab	6.2	7.1	8.2	9.7	1.0	1.4	15.30	19.17	32.64
Household	1.2	1.0	1.1	0.9	1.4	1.3	-14.16	-22.53	-0.41
Others	13.0	13.9	7.9	7.8	26.1	27.4	6.85	-2.13	4.94

Source: Registrar General, India (Census 2011)

Fig 1A: Age-Sex pyramid 2011- Rural

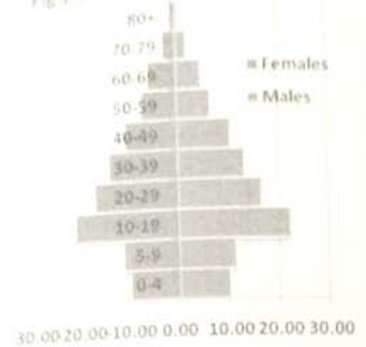
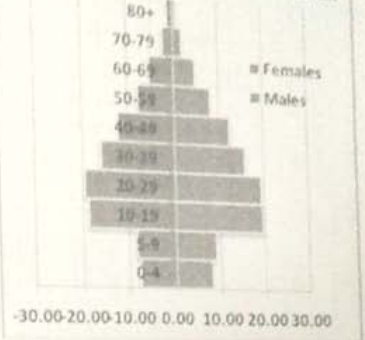


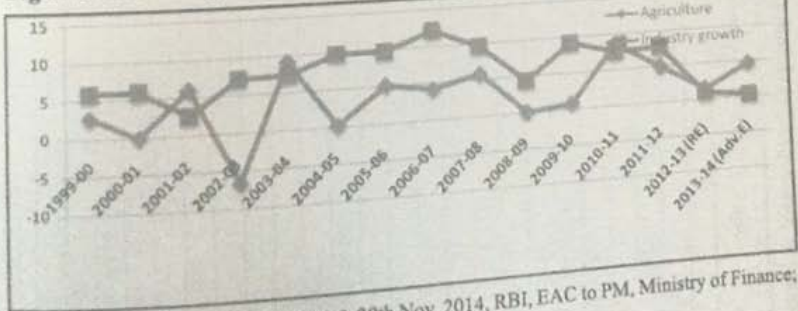
Fig1B: Age-Sex pyramid 2011- Urban



Source: Registrar General, India (Census 2011)

Table 3 also shows actual growth of population during 2001 to 2011. There are 18 per cent population has increased during 2001 to 2011 with annual exponential growth rate of 1.64 percent in India. In which 12 percent in rural and 32 percent in urban areas population has gone up. Higher number of population increased in Uttar Pradesh (UP) by 20 percent with 1.85 per cent per annum during 2001 to 2011. Total Fertility Rate (TFR) in 2001 was 3.4 and 2.3 in rural and urban that has declined in 2011 by 2.8 and 1.9 respectively (SRS, Registrar General, 2013). India has reached its fertility near to replacement level (TFR 2.5) even urban fertility is reached below replacement level (1.9). If exclude fertility of six major Indian states then country's fertility reached below replacement level. These states are Bihar, UP, Jharkhand, Chhattisgarh, MP, and Rajasthan have TFR above 3 and rest all the Indian states have TFR below replacement level in 2010 estimates (SRS, 2012).

Fig 2: Sector-wise growth rate, 1999 to 2014



Source: CSO Release 30th May 2014 & 29th Nov. 2014, RBI, EAC to PM, Ministry of Finance; 31st May, 2014 (Downloaded)

Table 3: Number of population and worker by sex and residence in 2001 and 2011 and percentage changes during 2001 to 2011

Item	Total		Rural		Urban		Change % 2001 to 2011		
	2001	2011	2001	2011	2001	2011	Total	Urban	
Total	1028610328	1210569573	742490639	833463448	286119689	377106125	17.7	12.3	31.80
Total worker	402234724	481743311	309956070	348597535	92278654	133145776	19.8	12.5	44.29
Main	313004983	362446420	229186552	245749270	83818431	116697150	15.8	7.2	39.23
Cultivator	103626068	95841357	101345252	92737696	2280816	3103661	-7.5	-8.5	36.08
Agricultural Lab	63497114	86166871	60517788	80958300	2979326	5208571	35.7	33.8	74.82
Household	12206084	12331464	8330814	7244556	3875270	5086908	1.0	-13.0	31.27
Others	133675717	168106728	58992698	64808718	74683019	103298010	25.8	9.9	38.32
Total	496453556	587447730	360887965	405830805	135565591	181616925	18.3	12.5	33.97
Total worker	127220248	149877381	111116917	121834467	16103331	28042914	17.8	9.6	74.14
Main	72857170	89297061	60085301	67714557	12771869	21582504	22.6	12.7	68.98
Cultivator	25367090	22823252	24909455	22267845	457635	555407	-10.0	-10.6	21.36
Agricultural Lab	22378045	30911944	21387471	29319234	990574	1592710	38.1	37.1	60.79
Household	4697071	4791343	3294467	3074203	1402604	1717140	2.0	-6.7	22.43
Others	20414964	30770522	10493908	13053275	9921056	17717247	50.7	24.4	78.58
Total	532156772	623121843	381602674	427632643	150554098	195489200	17.1	12.1	29.85
Total worker	275014476	331865930	198839153	226763068	76175323	105102862	20.7	14.0	37.97
Main	240147813	273149359	169101251	178034713	71046562	95114646	13.7	5.3	33.88
Cultivator	78258978	73018105	76435797	70469851	1823181	2548254	-6.7	-7.8	39.77
Agricultural Lab	41119069	55254927	39130317	51639066	1988752	3615861	34.4	32.0	81.82
Household	7509013	7540121	5036347	4170353	2472666	3369768	0.4	-17.2	36.28
Others	113260753	137336206	48498790	51755443	64761963	85580763	21.3	6.7	32.15

Source: Registrar General, India (Census 2011)

As we know that Indian economy is mixed and still more than 60 per cent of the population is depends upon agriculture for their survival. As mass is in India. Fig2 indicates that growth rate of agriculture is fluctuating year by year. It has passed negative growth rate (in 2000 and 2003) to about 9 percent (in 2004 and 2010) growth rate. Agriculture policy should be formulated based on the structure and composition of Indian population if all the conditions are constant. Even today Indian agriculture is rainfed and depends on monsoon.

From above statements it is clear that population growth and agriculture growth is the result of socio-economic, biological and environmental processes. Thus discipline of demography and agriculture extension education is interdependent and not mutually exclusive discipline in the area of research and development. Main focus of this paper is linking research in demography with research in agriculture extension to develop new dimension in research.

Objective

- To established relationship between agricultural extension and demography in research and development.
- To find out the linkage between agriculture extension and demography research.

Data and Methodology

Secondary and primary data have been used in this paper. Census of India 2001 and 2011, Sample Registration System (SRS), Central Statistical Organization (CSO), National Sample Surveys (NSS), National Family Health Survey (NFHS) and literatures. We have used primary data that has been collected during May to September 2011 from six villages in two districts of Bundelkhand region of UP. There were 360 farmers have been interviewed randomly along with focus group discussion. The analysis have been done with following formula-

$$\text{Work participation rate (\%)} = \frac{\text{Total no. of workers}}{\text{Total no. of population}} \times 100$$

$$\text{Knowledge level (\%)} = \frac{\text{No. of known items}}{\text{Total no. of Items}} \times 100$$

$$\text{Adoption level (\%)} = \frac{\text{No. of items or methods adopted}}{\text{Total no. of items or methods}} \times 100$$

$$\text{Migration Rate} = \frac{\text{Total number of migrants at specific period of time}}{\text{Total population at that time (mid year)}} \times K$$

(K=1000 or 100)

$$\begin{aligned} \text{Net Migrants} &= \text{In-migrants} - \text{Out-migrants} && \text{or} \\ \text{Out-migrants} &= \text{In-migrants} - \text{Net Migrants} && \text{or} \\ \text{In-migrants} &= \text{Out-migrants} + \text{Net Migrants} \end{aligned}$$

$$\text{Net Migration rate (Time T)} = \frac{\text{In - migrants - Out - migrants in Time T}}{\text{Total mid year population at time T}} \times 100$$

$$\text{Changes (\%)} = \frac{\text{No. of population in T2} - \text{No. of population in T1}}{\text{No. of population in T1}} \times 100$$

$$\text{Dependency ratio (\%)} = \frac{\text{Population < 15 years and 60 and above}}{\text{working age population (15 to 59 years)}} \times 100$$

Extension Education and Demography

Most of the agricultural statistician is more concerned about the quantitative analysis without knowing the attitude and perceptions of the farmers regarding farm problems. Demographers and extension specialists are more concerned about the study of attitudes of the youth towards family planning methods and agriculture innovations respectively followed by adoption of methods and innovations. Our argument is that all the demographers and extension specialists should have knowledge about the statistics and psychology but agricultural statistician need not know about the methods of extension and demographic events. Thus demography should be introduced in department of extension education.

Population and Agriculture Growth

Earlier we have discussed the trends and patterns of growth of population and agriculture. Agriculture scientist should developed innovation as per trends of population growth. For example, if there is high population growth but low land availability, then agriculture scientist should be developed methods of intensive cultivation of crops. Population growth and landholding size are negatively correlated and that influences use of land intensively that is one of the main passive agriculture inputs.

Migration and Agriculture: Remittances and Labour, Exposure of new technology in agriculture

As we know that there are three demographic events- birth, death and migration. Earlier migration was treated as third pillars of demography, but at present migration is in the first position in terms of number of cases and its frequency. Migration affects labour market at both place of origin and place of destination through the process of out-migration and in-migration respectively. Rural to urban migration is more prevalent in India due to economic reasons

followed by socio-political. Rural out-migration affects agriculture negatively and positively by loss of productive member of households and receiving remittances from migrant member respectively. Rural out-migration is one of the main causes of labour shortage in agriculture (Prasad, 2013). Migrant households are more exposed to new agriculture technology, new agricultural products, new varieties, new inputs and new methods of growing crops. Prasad (2014) found that most of migrant households (MHs) were aware about the new methods of cultivation of crops who were working agricultural labour in Haryana and Punjab. They have introduced new crops in their field that they were not growing. They (MHs) were also aware about weeding, timely irrigation, sufficient amount of fertilizer and exact quantity of seeds and quality of seeds more than non migrant households (NMHs). Most of MHs have used new innovation in agriculture (known Innovators, early adopters, early majority) and none of MHs were late majority and laggards. Ramachandran (2008) found two main reasons of labour shortage in agriculture. One is seasonal migration of agricultural labour from one district to another and others domestic workers sought to go abroad for lower trade callings (p.222).

Modern economic pattern such as liberalization, privatization and globalization (LPG) linked local labour market to the world labour market through migration process. Open economy provide opportunities for agrarian societies to seek job outside rural areas that led to labour migration and result of this increased of real wage rate in domestic agriculture sector (Karunagoda, 2004, p.89-90). Demographer has categorized migration process under LPG as internal migration (within country) and external migration (between countries or international migration). Migrants under this process are known as out-migrants and in-migrants (Table 5). External migrants are termed as immigrants (in-migrants to country) and emigrants (out-migrants from country). In-migration increased head counts whereas out-migration decreased the same in any geographic area. Thus migration affects supply and demand of labour and food grains. Remittances can be used in agriculture for boosting production. It indicates that researches in agriculture extension and in demography are compatible to each others. Agriculture scientist increased food supply corresponding to demographic phenomenon, and demographers take interest on research on food supply and fertility (population growth). Decadal growth of cereal demand 13 per cent and growth of demand of fruits, vegetables, eggs, chicken and milk is much more corresponding to population and income growth (Alagh, 2010). If extension specialists got to know that migrant households are more aware about the agricultural innovation then they easily identify progressive farmers' household that is the target beneficiary of agricultural scientists.

Table 5: Number of rural in-migrants, rural out-migrants and rural net migrants, during 1991 to 2001

Region	Total rural Population	Rural out-migration			
		Out	In	Net	Rate*
UTs	9,61,954	98,402	7,27,069	6,28,667	653.53
North	8,82,90,448	27,90,170	35,33,946	7,43,776	8.42
South	14,84,78,814	19,29,335	12,52,766	-6,76,569	-4.56
East	18,40,67,619	32,22,426	29,20,666	-3,01,760	-1.64
West	8,81,05,257	11,30,062	16,41,224	5,11,162	5.80
Central	19,87,52,702	38,54,414	31,61,097	-6,93,317	-3.49
North East	3,30,03,499	6,41,094	4,29,135	-2,11,959	-6.42

Source: Registrar General, India (2001)

Fertility, Landholding and Agriculture

There is strong relationship between fertility and landholding size and agriculture. High fertility is increasing demand of food, fibre, furniture, fodder, and fuel (5F) with decreasing size of field (landholding). Earlier 3F (food, fibre, furniture so called roti, kapara and makaan) are basic needs of every human and fodder for animal (for milk, meat, etc) and fuel (bio-diesel, organic oil) for transportation and machinery that is main symbol of modern economy. On one hand, due to high fertility landholding size would be decreased that led to either cooperative farming or intensive use of land for subsistence. On the other hand low fertility would be decreased labour supply to agriculture that led to mechanization of agriculture. On an average landholding size 1.16 hectare that big challenge for India (Agriculture Census, 2010). In case agricultural professional and demographer can development new dimensions in the field research that would directly linked with fertility and agriculture.

Demographic Dividend and Agriculture

India is hub of youth in the world and the time has come to harvest this demographic dividend for development of the nation. Fig1 clearly shows that majority of the population is belong to 15 to 59 years that is working age population. According to Census of India (2011) the total dependency ratio is 49.79 percent. It indicates that half of the population is in working and rest is dependent population. Due to city bright light effects and higher literacy

rate now rural youth is not interested in agricultural work. The negative attitude of the youth towards agriculture is one of the causes labour shortage in agriculture that influence labour intensive cropping pattern and cropping intensity negatively. That challenges would be in front of agriculture scientist and try to develop low labour intensive technology in crop production.

Knowledge, Attitude and Skill/Practice in Population and Agricultural Studies

The main aim of extension education is the development of individual and similarly demographer targets newly couple for reproductive and child health (RCH) as well as family planning. Both extension specialist and population scientists are interested to knowledge/awareness level, attitude scale and skill level towards agriculture innovation and contraceptives or family planning methods respectively. There is an extension approach of family planning methods. Awasthi and Prasad (2010) found out the awareness level and adoption quotients are positively correlated in pulse production technology. Rural fertility is higher than urban due to low awareness and acceptance of conceptive methods (NFHS-3). Both agriculture extension specialist and population scientist are studying news methods of agriculture and reproductive and child health.

Population and Food Security

It is well known that food security is the challenge for government as well as agricultural scientist. Agricultural production and its distribution among the mass directly depends upon the population size and its distribution. Because food habits the matter of socio-economic status of the households but food production is related to geographical and environmental factors. Population scientist would find out the trends and patterns of population growth and correspondingly agricultural scientist would produce agricultural products. If population is high then agricultural scientist would be concerned about the quantity of food and if it is optimum they would be more concerned about quality food. Food requirement is also varying with age and location. High fertility rate shows that high demand of milk and milk products whereas aging population needs fruits and vegetables.

Population Policy and Agriculture

Renowned agriculture scientist Dr. MS Swaminathan was the chair of national population policy 2002. Population policy cannot be separated from agriculture policy. Similarly research in demography should not be separated from agricultural extension for sustainable development.

Conclusions

The importance of demographer and agricultural scientist cannot be ignored in research and development. Sustainable development goals are basically related to research in agriculture and population related. Population growth directly influence climate and agriculture is influences by climate change directly. Population growth forced to exhaust natural resources and reduces land size that is main input of agriculture. India's fertility rates reducing and most of the states achieved TFR below replacement level. Population is increasing with decreasing rates across states. Food production is varying according to geographic location, landholding, socio-economic of the farmers, labour supply and demand, and market demands. Birth, death and migration affect population structure and composition of the locality that influences agriculture both positively and negatively. Research in the field of agriculture solely depends on the demographic trends in any geographic area.

Suggestions and recommendations

As agriculture and population is the core for sustainable development. Any research in agriculture would not be success without knowing the demographic patterns and population growth and its composition. None of the agriculture has department of population studies or demography. Even demography is the part of home sciences and family studies, but it should be core discipline in agriculture universities and colleges. Without knowing of the demography of the country, student could not understand the problems of nation as whole and food security would be success.

Our recommendations are that agricultural graduate should be studied demography as following headings:-

- Importance of demography in agriculture
- Demographic methods: Fertility, mortality, migration, population growth&projection
- Population Theories- By different thinkers
- Demographic structure and population composition and distribution: age, sex, rural-urban, caste, religion, region.
- Migration: theories, causes and consequences of migration
- Sources of demographic and agriculture data: census, NSS, NFHS, CSO, DLHS, SRS, agriculture census and animal census, etc.
- Population policies and strategies of population planning for sustainable development.
- Division of agriculture labour and Gender in agriculture: working age population, dependency ratio, and demographic dividend.

At post graduate level – research should be conducted by extension education discipline students. Such as population growth and agricultural growth; studies of agrarian demography and adoption of innovation, cropping pattern and household size, cropping intensity and population size of households, etc.

References

- Agriculture Census. 2010. Agricultural Land Holdings Pattern in India. NABARD Rural Pulse, Issue 1, Jan-Feb 2014, downloaded on 30th November 2015 from https://www.nabard.org/Publication/Rural_Pulse_final142014.pdf
- Awasthi, D.K. and Prasad, S. 2011. Pulse production technology in Hamirpur district. Monograph published by VDM publishing house, Germany.
- Alagh, Y.K. 2010. The Future of Indian Agriculture. Unpublished paper that was presented in International conference on agriculture growth held at JNU, New Delhi, organized G.S. Bhalla.
- Cain, M. 1985. On the relationship between landholding and fertility. *Population Studies*, 39: 5-15.
- Central Statistical Organization (CSO, 2014). India-Macro-economic Summary: 1999-00 to 2013- 2014 (On 1st December, 2014).
- Karunagoda, K. 2004. Changes in labour market and domestic agriculture. *Sri Lankan journal of agricultural economics*, 6(1): 82-97.
- Marquette, C. 1997. Turning but not toppling Malthus: Boserupian theory on population and environment relationship. Working paper:16, Development Studies and Human rights, Michelsen Institute.
- National Family Health Survey-3 (NFHS-3). 2007. International Institute of Population Sciences (IIPS), Mumbai.
- Prasad, S. 2013. Labour shortage in agriculture: Causes, Consequences and Solutions in "Internal Migration in India: Nature, determinants and consequences" edited by KK Bagchi, pp, 120-142.
- Ramachandran, S. 2008. Impact of globalization on agricultural labour, "Indian Agriculture: Challenges of Globalization" edited by Reddy *et al.*, published new century publications, New Delhi, pp, 217-231.
- Registrar General, India (2001). Census of India, 2001: Primary Census Abstract (PCA). New Delhi. Office of the Registrar General and Census Commissioner of India, Ministry of Home Affair.
- Registrar General, India (2011). Census of India, 2011: Primary Census Abstract (PCA). New Delhi. Office of the Registrar General and Census Commissioner of India, Ministry of Home Affair.
- Registrar General, India (2013). Sample Registration System (SRS) Statistical Report, 2013.

- Stokes, C.S.; Schutjer, W.A., and Bulatao, R.A. 1986. Is the relationship between landholding and fertility spurious? A response to Cain. *Population Studies*, 40: 305-311.
- Thomas, J.J. 2012. India's Labour Market during the 2000s: Surveying the changes. *Economic and Political Weekly*. Vol. XLVII (51): 39-51, December, 22.
- Tilakaratne, I.G. and Somaratne, H.M. 2002. Strategies to overcome the scarcity of agricultural labour: An empirical study of a rural village in the dry zone, *Annals of the Sri Lanka Department of Agriculture*, 4:399-406.