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### Contents

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<b>Hunger and Voice: Marginalization and Impoverishment towards a Chaotic Social Ecology</b>	<b>9</b>
Anannya Chakraborty, S.K. Acharya	
<b>Antibiotic Resistance from Indian Cuisine: A Matter of Well being and Health</b>	<b>15</b>
S.K. Bharti, Parveez Ahmad Para, Moloya Gogai, Anita, Sucharitha Devi, Rashmi H.B.	
<b>Effect of Irrigation Methods on Biometric Development of Litchi</b>	<b>21</b>
R.D. Bansod	
<b>The Estimation of Income, Livelihood and Productivity from Pulse Enterprise: The Analysis and Implication</b>	<b>25</b>
Sankar Kumar Acharya, Amitava Biswas, Subham Mandal, Riti Chatterjee, Anwesha Mandal	
<b>Managemental Strategies of Farm Animals During Transition Period</b>	<b>31</b>
D.N. Singh	
<b>Influence of Pruning on Yield and Quality of Guava: A Review</b>	<b>39</b>
Akash Sharma, V.K. Wali, Shilpi Kumar	
<b>Herbal the Harvest: The Business Profitability and Ecological Sustenance in India</b>	<b>47</b>
Dristika Jairu, S.K. Acharya	
<b>Guidelines for Authors</b>	<b>51</b>

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## Hunger and Voice: Marginalization and Impoverishment towards a Chaotic Social Ecology

Anannya Chakraborty<sup>1</sup>, S.K. Acharya<sup>2</sup>

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### Author's Affiliation

<sup>1</sup>PhD Scholar, <sup>2</sup>Professor, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal 741252, India.

### Corresponding Author:

**Anannya Chakraborty**, PhD Scholar, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal 741252, India.

E-mail: [chakraborty.ext@gmail.com](mailto:chakraborty.ext@gmail.com)

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### Abstract

After 72 years of independence India is still suffering from the malicious problem of hunger and poverty. In the recent report produced by International Food Policy Research Institute (IFPRI) India ranked 100TH in terms of hungry children and women, in count and status, whereas, 21.7 percent of it's people are below the poverty line. According to National Crime Record Bureau, in the year 2015 the total numbers of farmers who have committed suicide is 5670. A survey of FAO reveals that nearly 75 percent of food insecure and vulnerable people are directly or indirectly related to agriculture. Another report of FAO has revealed that about 78 percent of the farmers are ready to quit agriculture. This is really alarming as well as distressing while we have made a call for complete digitization to create ICT driven modern India. Even in chronic hunger India's position is worse than African countries and also some neighbouring countries like Bangladesh. Hunger is associated with poverty that refrain poor people to accept ample of food, in quantity and quality. If hunger is the consequence, poverty is certainly the cause and if both poverty and hunger are the consequences, the silence is the cause that is invasive, intrinsic and invisible by nature (sometimes may be). Hunger is a status which makes us physiologically stressed and weak, mentally insulated and psychologically depressed. Poverty can be measured in terms of income. In other way the other forms of poverty are educational starvation, cultural deprivation and social depletion. Silence can be perceived in terms of inability of a person to raise voices against discrimination, both social and economic atrocities as well as a decision to go silent whenever it needs to utter voices. On this preamble the present study was conducted in Beraberi GP under Nadia district of WB. 150 respondents were selected purposively and they were interviewed thoroughly with a structured interview schedule. The results of the study reveals that the cobweb of hunger are poverty are creating a chaotic situation as far as the social and economic issues are concerned. Miscommunication or no communication has been triggered as the root cause of this disillusionment.

**Keywords:** Chaos; Communication; Chronic Hunger; Hunger; Poverty; Social Ecology.

### Introduction

Even with the swashbuckling claim on growth and prosperity on the present civilization, the other

side of this prosperity is so bleak and disastrous that have no match for the past centuries even. Out of around 7 billion population of the world, 1.5 billion are hungry. They don't have adequate access to food, if it is there, the quality doesn't stand

any where near to fulfil their calorie requirement. In India 350 million people are living below the poverty line and of them, 200 million people have become victim to moderate to extreme hunger indexes. 42 percent of the new born babies are under weight. 60 percent of the children are suffering from moderate to high level of anaemia experiencing stunted growth.

Beyond the curtain of hunger, there is another problem that is chronic hunger. Based on hunger index we the nation is occupying 100<sup>th</sup> position in the world (IFPRI Report, 2017). The scenario of chronic hunger is even worse and astoundingly it is worse than African nations as well.

#### *What is Hunger*

Everyone feels hungry on a daily basis. Most people are able to satisfy this craving and need. Even if not immediately, they can count on having a meal or snack within hours. This is not the type of hunger that Bread is concerned with.

People who suffer chronic hunger don't have the option of eating when they are hungry. They do not get enough calories, essential nutrients, or both. People who are hungry have an ongoing problem with getting food to eat. They have a primary need – how to feed themselves and their children today and tomorrow. They have little energy for anything else.

In politics, humanitarian aid, and social science, **hunger** is a condition in which a person, for a sustained period, is unable to eat sufficient food to meet basic nutritional needs.

Throughout history, portions of the world's population have often experienced sustained periods of hunger. In many cases, this resulted from food supply disruptions caused by war, plagues, or adverse weather. For the first few decades after World War II, technological progress and enhanced political cooperation suggested it might be possible to substantially reduce the number of people suffering from hunger. While progress was uneven, by 2000 the threat of extreme hunger subsided for many of the world's people. According to the WFP some statistics are that, "Some 795 million people in the world do not have enough food to lead a healthy active life. That's about one in nine people on earth. The vast majority of the world's hungry people live in developing countries, where 12.9 percent of the population is undernourished."

Until 2006, the average international price of food had been largely stable for several decades. In the closing months of 2006, however, prices began to rise rapidly. By 2008, rice had tripled in

price in some regions, and this severely affected developing countries. Food prices fell in early 2009, but rose to another record high in 2011, and have since decreased slightly. The 2008 worldwide financial crisis further increased the number of people suffering from hunger, including dramatic increases even in advanced economies such as Great Britain, the Eurozone and the United States.

The Millennium Development Goals included a commitment to a further 50% reduction in the proportion of the world's population who suffer from extreme hunger by 2015. As of 2012, this target appeared difficult to achieve, due in part to persistent inflation in food prices. However, in late 2012 the UN's Food and Agriculture Organization (FAO) stated it is still possible to hit the target with sufficient effort. In 2013, the FAO estimated that 842 million people are undernourished (12% of the global population). Malnutrition is a cause of death for more than 3.1 million children under 5 every year. UNICEF estimates 300 million children go to bed hungry each night; and that 8000 children under the age of 5 are estimated to die of malnutrition every day.

#### *Hunger and India*

India continues to have serious levels of widespread hunger forcing it to be ranked a lowly 100 among 118 developing countries for which the Global Hunger Index (GHI) was calculated in the year 2017 (IFPRI Report). Countries worse than India include extremely poor African countries such as Niger, Chad, Ethiopia and Sierra Leone besides two of India's neighbours: Afghanistan and Pakistan. Other neighbours Sri Lanka, Bangladesh, Nepal and China are all ranked above India. The GHI is calculated by taking into account four key parameters: shares of undernourished population, wasted and stunted children aged under 5, and infant mortality rate of the same age group. Of the 131 countries studied, data was available for 118 countries. This year, for the first time, two measures of child hunger -wasting and stunting -have been used to give a more complete picture. Wasting refers to low weight in relation to a child's height, reflecting acute under nutrition. Stunting refers to the deficiency in height in relation to age, reflecting chronic under nutrition. The International Food Policy Research Institute (IFPRI) makes the annual calculations of GHI. Basing its readings on the most recent data, the 2016 GHI for India was derived from the fact that an estimated 15% population is undernourished -lacking in adequate food intake, both in quantity

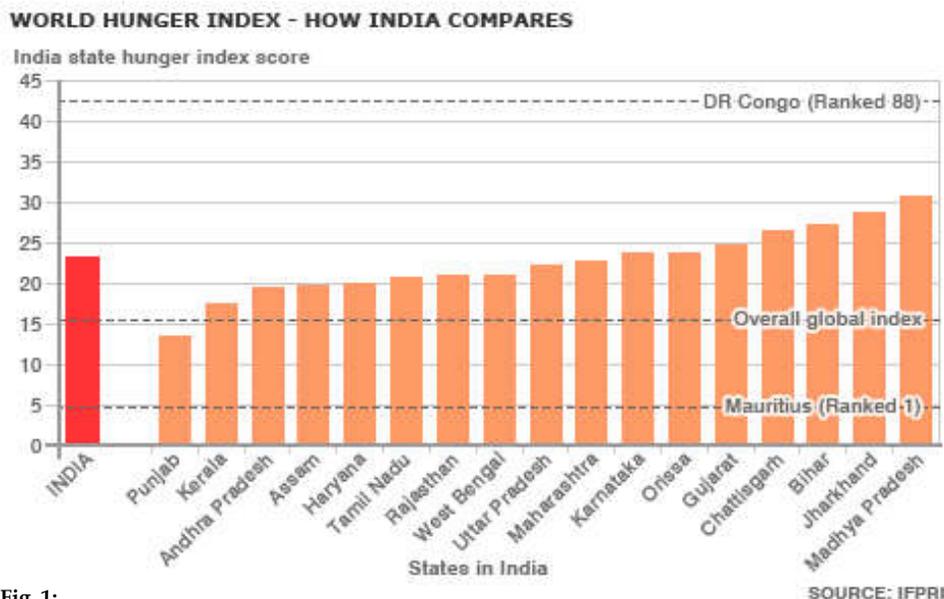


Fig. 1:

and quality. The share of under-5 children who are 'wasted' is about 15% while the share of children who are 'stunted' is a staggering 39%. This reflects widespread and chronic lack of balanced food. The under-5 mortality rate is 4.8% in India, partially reflecting the fatal synergy of inadequate nutrition and unhealthy environments.

#### *Silence: The Cause of Hunger*

In the modern civilized era there are two sides of the world: haves and have nots. One side is happy and prosperous with all the modern amenities and comforts of life, at the same time the other side is living in the dark and dearth of extreme poverty and hunger. But why is the discrimination? Is it because of the uneven distribution of resources? Inaccessibility of information? Lack of awareness about their rights? Or because simply of their silence?

We can cite many of the examples where the deprived section of the society when broke their silence, they just burst like a volcano and turn the society into ashes. For example we can say about the Cuba Movement Fidel Castro, Vietnam movement, Naxal movement of India etc.

So, we can say that if hunger is to be eliminated we have to reduce poverty and if we have to eradicate both hunger and poverty, silence is to be broken and empowerment is to be put in place.

#### *Objectives*

1. To delineate the present status of hunger, poverty and voice as prevalent amongst the target research group.

2. To isolate the variables, dependent and independent in order to study their interactive relationship.
3. To elucidate the contributory factors characterizing both voice and hunger and the perceived interdependence.
4. To generate a microlevel policies for making appropriate interventions.

#### *Research Locale*

The present study was conducted in the Beraberi gram panchayat under Habra block in the district of Nadia, West Bengal.

#### **Materials and Methods**

The village was selected purposively according to the convenience of the researcher. Then from this village 140 respondents (all women) were selected randomly and they were interviewed through a structured interview schedule. The statistical tool used in this study is step down regression.

#### *List of Variables*

##### *Causal variables*

Variables	Notation
Age	X <sub>1</sub>
Education	X <sub>2</sub>
Family size	X <sub>3</sub>
Economic motivation	X <sub>4</sub>

Risk orientation	X <sub>5</sub>
Management orientation	X <sub>6</sub>
Stress perception on hunger	X <sub>7</sub>
Stress perception on poverty	X <sub>8</sub>
Stress perception on voice	X <sub>9</sub>
Size of holding	X <sub>10</sub>
Cropping intensity	X <sub>11</sub>
Livestock count	X <sub>12</sub>
Livestock yield	X <sub>13</sub>
Pond and fish	X <sub>14</sub>
Total crop yield	X <sub>15</sub>
Cost of cultivation	X <sub>16</sub>
No. of fragments	X <sub>17</sub>
Communication variables	X <sub>18</sub>
Marketed surplus	X <sub>19</sub>
Energy consumption	X <sub>20</sub>
BMI	X <sub>21</sub>

*Consequent variables*

Variables	Notation
Hunger	Y <sub>1</sub>
Voice	Y <sub>2</sub>

**Results and Discussion**

*Step down regression: Hunger vs. 21 causal variables*

The above model presents the multiple regression

analysis between criterion variable Hunger vs. 21 causal variables. It has been found that the variable cropping intensity (X11), risk orientation (X5), livestock count (X12) and total crop yield (X15) have contributed substantially to the variance embedded with the consequent variable hunger.

The R<sup>2</sup> value being 0.506, it is to infer that 50.6 percent of variance in the consequent variable has been explained by the combination of these 21 causal variables.

The above model also depicts that the 4 causal variables those are cropping intensity (X11), risk orientation (X5), livestock count (X12) and total crop yield (X15) have been retained at the last step.

The R<sup>2</sup> value being 0.303, it is to infer that 30.3% of variants in the consequent variable has been explained by the combination of these 4 causal variables.

*Revelation*

The rural people are mostly affected by hunger because of their poor risk bearing capacity, declining livestock count, overall declination of profit and ultimately low intensity of cropping. Low cropping intensity subsequently leads to low crop yield. Low livestock count leads to low amount of family resources which ultimately leads to higher level of hunger.

Step down regression: Hunger vs. 21 causal variables

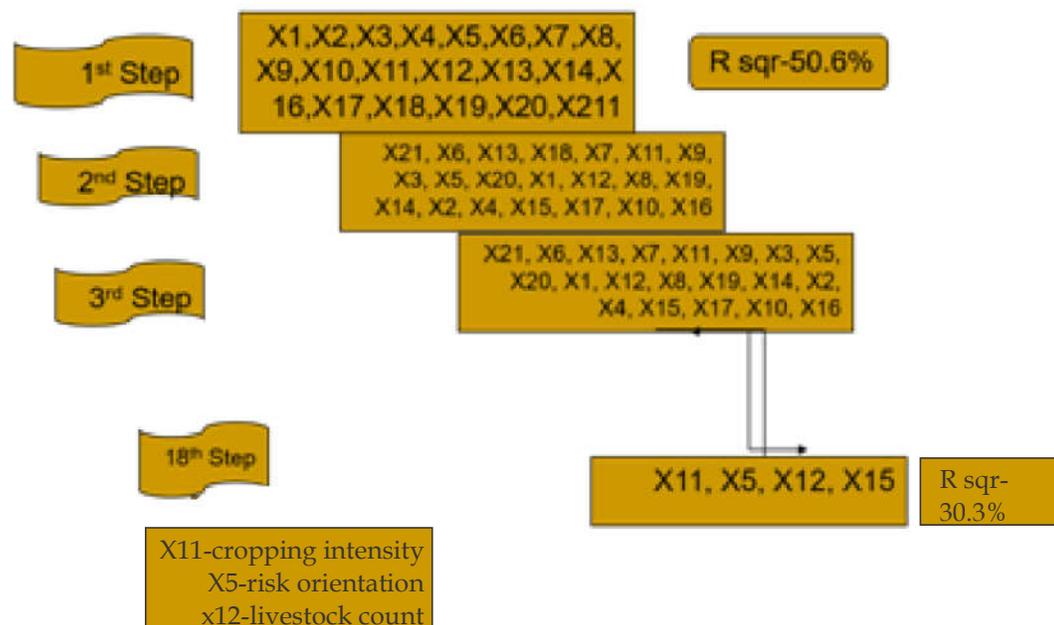


Fig. 2: Step down regression: Hunger vs. 21 causal variables

### Step down regression: Voice vs. 21 causal variables

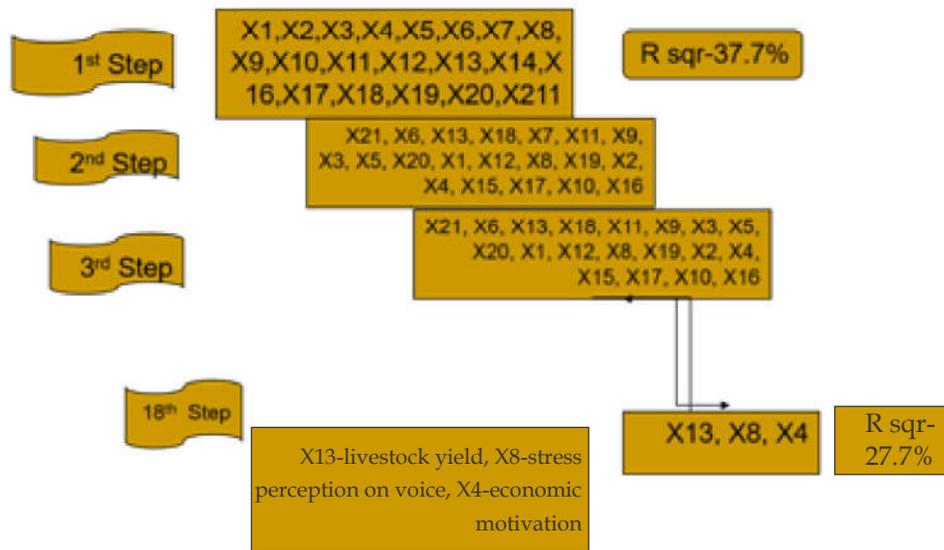


Fig. 3: Step down regression: Voices vs. 21 causal variables

#### **Step down regression: Voices vs. 21 causal variables**

The above model presents the multiple regression analysis between criterion variable Voices vs. 21 causal variables. It has been found that the variable economic motivation (X4), livestock yield (X13) and stress perception on voice (X8) have contributed substantially to the variance embedded with the consequent variable voice.

The  $R^2$  value being 0.377, it is to infer that 37.7 percent of variance in the consequent variable has been explained by the combination of these 21 causal variables.

The above model also depicts that the 3 causal variables those are economic motivation (X4), livestock yield (X13) and stress perception on voice (X8) have been retained at the last step.

The  $R^2$  value being 0.277, it is to infer that 27.7% of variants in the consequent variable has been explained by the combination of these 3 causal variables.

#### *Revelation*

Stress has been identified as being responsible for increasing silence and fatigued voices, either to defend themselves from poverty or to inflicting hunger and thereafter it has contributed to poor economic motivation.

#### **Conclusion**

A survey was done by FAO in 2009. A key objective of the Voices of the Hungry project

(VoH) is to estimate comparable prevalence rates of food insecurity in national populations for more than 140 countries every year. These estimates are based on conditions and behaviors reported by adults through the Food Insecurity Experience Scale survey module (FIES-SM). The data collected in nationally representative surveys of the adult population in each country are used to compute a measure of severity of the food insecurity status for each respondent, focusing on conditions reflecting limited access to food. Individual measures are then calibrated against a common global reference scale of severity, thus allowing classifications and estimates of prevalence rates that are comparable across countries and population groups. So, following a similar trend here in this study also hunger and voice can be found interrelated with each other. They have got a wave of interaction as well. The study suggests that the aspect of making stakeholders shouting for the cause can have enough logic in fighting of poverty, rather than opting for a furtive silence of course within a tent of performing agro ecosystem. The other factors are like yield, cropping intensity, livestock count can come up as decisive factors along with the socio-psychological components like voice and communication.

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## Antibiotic Resistance from Indian Cuisine: A Matter of Well being and Health

S.K. Bharti<sup>1</sup>, Parveez Ahmad Para<sup>2</sup>, Moloya Gogai<sup>3</sup>, Anita<sup>4</sup>,  
Sucharitha Devi<sup>5</sup>, Rashmi H.B.<sup>6</sup>

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### Author's Affiliation

<sup>1</sup>Assistant Professor, Department of LPT, College of Veterinary Science and Animal Husbandry, DUVASU, Mathura, Uttar Pradesh 281001, India.

<sup>2</sup>Assistant Professor, Department of LPT, Arawali Veterinary College, Sikar, Rajasthan 332001, India. <sup>3</sup>Assistant Professor, Department of Foods & Nutrition, Assam Agriculture University, Jorhat, Assam 785013, India. <sup>4</sup>Assistant Professor, Department of LPT, College of Veterinary and Animal Sciences GBPUAT, Pantnagar, Uttarakhand 263145, India.

<sup>5</sup>Assistant Professor, Department of Food and Nutrition, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana 500030, India.

<sup>6</sup>Assistant Professor (PHT), Department of Post harvest Technology, College of Horticulture, University of Horticultural Sciences, Bagalkot, Karnataka 587104, India.

### Corresponding Author:

**Sanjay Kumar Bharti**, Assistant Professor, Department of LPT, College of Veterinary Science and Animal Husbandry, DUVASU, Mathura, Uttar Pradesh 281001, India.

E-mail: [drskbharti@gmail.com](mailto:drskbharti@gmail.com)

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### Introduction

For more than 60 years, antibiotics have been regarded as the panacea to treat microbial diseases. Since then, the greatest threat to the use of antimicrobial agents for therapy of bacterial infections has been the development of antimicrobial resistance in pathogenic bacteria. Among increased alarming emergence in developing countries

### Abstract

Antibiotics are a major contraption exploited by the health care industry to curb bacterial infections. Consequently, unscrupulous practice of antibiotic plays a considerable role in emerging public health threat of broad concern to countries and multiple sectors crisis of antibiotic resistance. The concern becomes more considerable on future perspective as the global exploitation of antimicrobials for food animal production. Antibiotic residues from food have a dual concern; one is the potential threat of development of toxicity to humans and second is possible expansion of resistant strains and failure of antibiotic therapy in clinical cases. Even upon such perilous effect, the indiscriminate use of antibiotics indicates that antibiotic resistance is still a marginally concern question in India, where the use of antibiotics in agriculture is extensive.

**Keywords:** Antibiotic resistance; Food; RTE; Meat; Milk.

like India, World Health Organization has acknowledged this contention as one of the most imperative health issues of the 21<sup>st</sup> century (Cohen & Denning 2017). In India, pervasiveness of high infectious disease in human as well as in animals, easy accessibility of antimicrobial proprietary over the counter and the indiscriminate use of antimicrobial agents are the recognized reason for antimicrobial resistance (Kumar, 2016). The limited references available indicate that antibiotic

resistance is a major predicament in India, and the use of antibiotics in agriculture and livestock sector is widespread. The food chain can be contemplated as the primary route of transmission of antibiotic resistant organism between the agriculture (plant and livestock) and human. The egress of the hazard is also very significant as the drug resistant microbes can easily move from the farm to fork and from one person to the next and further enhanced by increasing cross border movement of human, animals and foodstuffs. The solemn nature of the resistance to such antibiotics has become one of the burgeoning concerns to global public health.

The generations of antibiotics used in agriculture (plant and livestock) especially in food-producing animals and in human are usually same, thereby growing the probability of emergence and proliferation of resistant towards certain class of bacteria. Agricultural livestock and Food-producing animals endure compelling reservoirs of such pathogens which are having huge potential to transfer resistance to human population. In case of aquaculture, antibiotic doses can be proportionately higher in comparison to livestock. The foremost reason of this elevated residue is the use of antibiotics in fish feed, which remain in the aquatic environment for an extensive period of time, providing an additional effect along with the residues remain in the fish products.

Some studies approximated that the quantity of antibiotics used for crops is relatively low in comparison to the quantities used in livestock. The estimate of antibiotic used ranging from 0.2 to 0.4% of total agricultural antibiotic utilization (Smalla and Tiedje 2014). The increased use of fungicides in humans alongside with agriculture has intended the severity of the resistance globally.

Further advanced study and data's are required on the antibiotics need, use and consumption in agriculture, food and treatment sector so as to make polices nationally and globally in order to condense the incidence of antimicrobial resistance. There is further need by farming industry and regulatory bodies to examine the pattern of antibiotic consumption in order to identify priority areas for intervention where these hazards can be prevented or eliminated. Several food sources are recognized as the vigor for antibiotic resistance, such as

### **Antimicrobial resistance from ready to eat processed foods**

Processed foods can be contaminated with

antimicrobial resistance pathogens or antimicrobial resistance genes in three broad ways:

#### ***1. Antibiotics usage during primary stages of production***

##### *a. Antibiotics use in agricultural farm*

Antibiotics used during initial agricultural production may lead to contamination of plant products with these resistant organisms. These antimicrobial resistant bacteria can be present in soil, water, human or animal fecal material results in presence of such resistant bacteria in the final produce.

##### *b. Antibiotic use in conventional livestock production*

According to study of Van *et al.* (2015) India be the fourth amongst top five most countries in terms of antimicrobial use in livestock production. Laxminaraya and Chaudhury (2016) shown antimicrobial residues in food animal products (such as chicken meat and milk) from various regions of India. In addition to meat and milk, Harsha *et al.* (2011) reported antibiotic-resistant bacteria from eggs, fish, and seafood as well. The similar studies indicating that antibiotic use in food animal production is arbitrary and widespread India.

#### ***2. Intentional assimilation during food processing***

Microorganisms used during production of fermented foodstuffs may contain antimicrobial resistance genes and can transfer them to the pathogenic bacteria. Microbes used in starter culture for yogurt, fermented sausages, curds, probiotics (yoghurt, health foods, and beverages), bacteriophages (soft cheese, fish/chicken products etc.) or biopreserving microorganisms (fermented foods, boiled meat products etc) are the most important products which can transmit these genes during processing intentionally.

#### ***3. Cross-contamination during food processing***

Transfer of antimicrobial resistant bacteria or their genes may occur at any stage during processing of the processed food products. During food preparation, pathogenic organisms maybe transferred to food items by the handler both directly or by cross contamination through hands, surfaces, utensils and equipments that have been inadequately clean and disinfected between the preparations of different types of foods. Microbial

contamination is further reported in drains, mats, coolers, air fillers, wall, cleaning utensils and other environments that are wet, cold and difficult to clean, where microbes can survive for long periods due to their ability to form biofilms and resist to bactericidal agents that causes bacterium stresses.

### **Prevalence and Antibiotic Resistance in processed foods**

#### *Milk and Milk Products*

Contamination of milk and dairy products by pathogenic micro-organisms can be of endogenous origin, following excretion from the udder of an infected animal and /or exogenous origin, through direct contact with infected herds or through the environment. Microorganisms can be transmitted to humans through contaminated and untreated milk and milk products. Milking operations, including storage, handling and transportation are considered as critical points that contaminate milk products. *Staphylococcus aureus* present on the skin and mucosa of food producing animal reservoirs is frequently associated with sub-clinical or clinical mastitis leading to the contamination of dairy products. Chauhan *et al.* (2015) studied the prevalence and antimicrobial resistance of *Staphylococcus aureus* isolated from raw milk (cow and sheep) and dairy products. Tambekar *et al.* (2011) found that, ice creams in Amaravathi, Maharashtra, were contaminated with *Salmonella* spp and *E.coli*. Kalsoom *et al.* (2009) studied the prevalence of food borne pathogens in milk products, khoya and burfi. *Staphylococcus aureus*, *Escherichia coli* and *Klebsiella* spp., was found prevalently in a bulk number of khoya and burfi samples throughout. *S. aureus* expressed the major part of any bacterial flora present over burfi and khoya samples. Certain spp. Like *Enterobacter* and *E. coli* represented approximately 1.2%, in both burfi and khoya samples. *Klebsiella* spp., *Enterobacter* spp., and *E. coli* were found to be resistant to Urixin.

#### *Meat and Meat Products*

Isolation of *Staphylococci* species from meat demonstrated that they have entered the food chain to affect the food safety and public health. Antibiotic-resistant *Salmonella*, *Campylobacter*, *E. coli* and multidrug-resistant *Staphylococcus* have been detected in many different types of retail meat and poultry products. Saravanan *et al.* (2015) found that 21 of 1215 samples collected at 154 different farms in Southern India were positive for non-typhoidal

*Salmonella*. Sixteen were classified as *S. typhimurium* and 5 as *S. enteritidis*, both strains highly associated with human disease whereas every isolate were found resistant to oxytetracycline, which is a custom feed additive in poultry industry. Another survey of backyard layers in West Bengal isolated *Salmonella* in cloacal swabs, feed samples, drinking water samples, and eggs. The isolated isolates were found resistant to norfloxacin, chloramphenicol, gentamicin, levofloxacin, oxytetracycline and ciprofloxacin, (Samanta *et al.*, 2014). A similar study of Hemlata *et al.* (2015) instituted that 96% of chicken samples collected from local meat shops of Bikaner containing *S. aureus*.

#### *Sea foods*

The faecal contamination of natural water bodies has emerged as a major challenge in developing and densely populated countries. Antibiotic-resistant pathogens have tremendously reported from seafood products obtained from India as well. For example, the trimethoprim-sulfamethoxazole (SXT) resistance of fish pathogen aeromonads isolated from seafood products in Germany (Kadlec *et al.*, 2011). Done *et al.* (2015) reported level of resistance consistently increasing in all food animals including aquaculture. Kumar *et al.* (2016) investigated the occurrence of methicillin-resistant staphylococci in fresh seafood, seafood products and related samples. Deekshit *et al.* (2012) tested *Salmonella* isolates from fish and shellfish from markets and fish landing centres in Mangalore for nine antibiotics in which two-third were found resistant to at least two antibiotics, and a quarter of the isolates were found resistant to three or more drugs taken in the study.

#### *Ready-to-Eat and Restaurant foods*

Ready-to-eat foods include processed dairy, meat, seafood and vegetable products and restaurant foods are usually ingested directly without further thermal processing. Therefore, they could be a vehicle for the spread of Antibiotic-Resistant Microorganisms. The ready-to-eat foods are usually kept at room temperature which causes germination and multiplication of *B. cereus* (Sandra *et al.*, 2012). The same problem may occur when foods such as pasta and pizza are stored for long periods of time at room temperature (Tiwari and Abdullah, 2015). The microbiota of RTE foods are affected by the microorganisms associated with raw materials, as well as by post harvest processing, handling and storage procedures

before consumption (Khairuzzaman *et al.*, 2014). Meat samples (mutton tikka and chutney samples) collected from Kashmir valley, showed 45 % prevalence of *B. cereus* in mutton tikka and 32.5 % in the chutney samples (Hafiz *et al.*, 2012) and 16% in the raw milk (Altaf *et al.*, 2012).

#### *Street vended foods*

The hygiene aspects of vending operations are a poorly maintained in India, like stands are often crude structures, running water, washing facilities, are inadequately available. Washing of hands, utensils and dishes often is done in buckets or bowls. Unorganised waste disposal and improper disinfection attracts insects and rodents around. Moreover, food is not well protected from flies and refrigeration is not available (Cuprasitru *et al.*, 2011). *Salmonella sp.*, *Shigella sp.*, *Listeria sp.* and other food borne pathogens were identified in street foods in different studies carried out in India (Sharma and Mazumdar, 2014).

#### **Impact of food borne antimicrobial resistance on well being and health of consumers**

It has been reported that 700,000 children in one WHO region in Southeast Asia die of unsafe food yearly. Antimicrobial resistance is one of the main threats to modern medicine. Firstly there is the immediate risk that medical treatment may fail. Secondly, the choice of antibiotics for treatment is limited and third is that the resistant GI pathogens may acquire even more resistance when treated with antibiotics for other medical reasons. Thereafter, the chances of higher risk also exist in that of increased virulence which maybe due to a co-selection of resistance and virulence properties through integration of virulence and resistance plasmids. Hence the need of the moment at present is to implement effective and efficient intervention programs that could help reduce burden of FBDs. Such intervention should include food safety education and awareness, good food handlers' hygiene and national FBD occurrence surveillance and monitoring programs. Similarly, a comprehensive systematic review of occurrence and prevalence of FBDs and antibiotic resistance in developing countries needs to be carried out as adequate information is lacking, thereby making it difficult to take proactive intervention steps toward prevention of these diseases. There is also need for research scientists in developing countries to investigate occurrence of FBDs in each country and also across borders.

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E-mail: sales@rfppl.co.in

## Effect of Irrigation Methods on Biometric Development of Litchi

R.D. Bansod

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### Author's Affiliation

Head, Dept. of Soil and Water  
Conservation Engg, Mahatma Phule  
Krishi Vidyapeeth, Rahuri, Maharashtra  
413722, India.

### Corresponding Author:

R.D. Bansod, Head, Dept. of Soil and  
Water Conservation Engg, Mahatma Phule  
Krishi Vidyapeeth, Rahuri, Maharashtra  
413722, India.

E-mail: [rtuljapur1808@gmail.com](mailto:rtuljapur1808@gmail.com)

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### Abstract

The comparative effect of different methods of irrigation such as, microsprinkler + drip ( $T_1$ ), surface ( $T_2$ ) and surface + drip ( $T_3$ ) was studied on Biometric development of Litchi. Surface and microsprinkler irrigation were applied to Litchi when there was intercrop, however drip irrigation was applied during lean period (no intercrop period). The highest crop canopy, 12.10 m<sup>2</sup> was recorded in  $T_1$  and lowest, 10.50 m<sup>2</sup>, in  $T_2$ . The maximum girth (29.0 cm), shoot length (49.2 cm) and plant height (288.25 cm) were recorded in  $T_1$ . The yield of Litchi obtained in  $T_1$ ,  $T_2$  and  $T_3$  was 374.72, 271.48 and 300.27 kg/ha respectively. The number of fruits, fruit weight and fruit diameter were also maximum in  $T_1$ . The significant increase of yield in  $T_1$ , 38.02% over  $T_2$  and 10.60% over  $T_3$  and overall better performance of Litchi in  $T_1$  was might be due to frequent irrigation, uniform moisture distribution in the soil profile and better utilization of nutrients by the crop for its full growth during intercrop period.

**Keywords:** Biometric; Irrigation Methods; Litchi

### Introduction

The field experiment was conducted, to study the response of litchi to different methods of irrigation in respect of biometric development and yield components. In between the litchi cucumber and cauliflower were taken as intercrops. The irrigations were applied by surface irrigation method and also by water saving methods such as drip and microsprinklers were used as irrigation methods. Under drip irrigation the soil moisture is maintained at field capacity and throughout the growth period, resulting into higher yield of yield parameters of tomato (Danawale N.J. *et al*, 2018).

### Materials and Methods

#### *Irrigation treatments for litchi*

The irrigation treatments were based on the period of intercrops and the lean period. The irrigation was applied to litchi and intercrops by microsprinkler and surface irrigation methods during the intercropping period. During the initial and harvesting stages of intercrop the water demand of litchi was fulfilled through drip method to avoid the overirrigation to litchi. During the lean period (when there was no intercrop), the irrigation was applied through drip and surface. The information

of irrigation treatments applied in litchi is given in Table 1. In case of microsprinkler + drip treatment, no separate laterals were required however, the laterals used for the microsprinklers (12 mm) were brought in use with some arrangement for drip irrigation so as to reduce the cost of extra laterals. The laterals and the drippers were placed near the litchi at a grid of 8 m x 8 m. In case of surface irrigation method, basin method of irrigation was applied.

**Table 1:** Treatments details

Treatment	Period	
	When there was intercrop	No intercrop (Lean) and gap period
Microsprinkler + Drip (T <sub>1</sub> )	Microsprinkler	Drip
Surface (T <sub>2</sub> )	Surface	Surface
Surface + Drip (T <sub>3</sub> )	Surface	Drip

#### Experimental details

In addition to the various components of experimental set up used for cauliflower and cucumber intercropping, the pressure compensating drippers of 4 l/h discharge capacity were used for the drip irrigation under microsprinkler + drip and surface + drip treatments. The details of the experiment are presented in Table 2.

**Table 2:** Experimental details of litchi

Sr. No.	Particulars	Irrigation method		
		Microsprinkler + Drip	Surface + Drip	Surface
1.	Plot size, m x m	32 x 40	16 x 40	16 x 40
2.	Plant spacing, m	8 x 8	8 x 8	8 x 8
3.	No. of rows in each plot	4	2	2
4.	No. of plants in each row	5	5	5
5.	Total no. of plants in each treatment	8	10	10
6.	No. of obs. plants	8	8	8
7.	Lateral spacing, m	8	8	-
8.	Spacing between emission devices, m	8	8	-
9.	No. of microsprinklers in corresponding plot	8	-	-
10.	No. of emitters in corresponding plot	16	20	-

#### Irrigation scheduling and water application

Irrigation water management to litchi was mainly based on intercropping and lean period. During

the intercropping period irrigations were applied by surface and microsprinkler methods however during lean period, irrigations were applied through drip irrigation system in two treatments (T<sub>1</sub> and T<sub>3</sub>). The water application and irrigation scheduling for respective irrigation treatments were as given below.

#### Drip irrigation

Drip irrigation system operates at lower pressure as compared to sprinkler and microsprinkler irrigation systems. Water application near the root zone with lower rate is possible through the emitting device, dripper. The irrigation requirement was estimated by considering crop coefficient during growth period and pan evaporation data.

The method given by INCID (1994) was used for estimation of crop water requirement. The following relationship was used for estimation of crop water requirement.

$$V = K_p \cdot E_p \cdot K_c \cdot W_p$$

Where,

V = Water requirement of the plant, l/day

K<sub>p</sub> = Pan coefficient

E<sub>p</sub> = Pan evaporation, mm/day

K<sub>c</sub> = Crop coefficient

W<sub>p</sub> = Wetted area, m<sup>2</sup>

The K<sub>c</sub> values for litchi were obtained by the method suggested by Doorenbos and Pruitt (1977) as experimentally determined values of K<sub>c</sub> were not available.

#### Surface irrigation

The irrigation scheduling in this treatment was given on the basis of 50 per cent depletion of the total available soil water in the effective root zone. The depth of irrigation was applied in the range of 5 to 6 cm. Soil samples were taken before and after each irrigation to measure the moisture content in the profile and measured quantity of water was applied in the basin having 25 m length and 0.6 m width when the soil moisture depleted 50 percent. The irrigation scheduling of the litchi during the intercrop period was based on the irrigation scheduling of the inter crop.

The observations of different growth and yield parameters such as plant height, girth, shoot length, canopy area, number of fruits per plant, fruit weight, and yield of litchi were recorded at an

interval of 45 days with starting the first observation from 1490<sup>th</sup> day of planting of litchi.

## Results and Discussions

### *Effect of methods of irrigation on biometric growth parameters of litchi*

#### *Biometric parameters of litchi*

The observations from eight tagged plants from each treatment related to canopy area, plant height, girth and shoot length of litchi were recorded at an interval of 45 days. The respective results obtained are presented as under.

#### *Canopy area*

The canopy area of litchi was recorded under different irrigation treatments at an interval of 45 days. It is observed that the irrigation method, microsprinkler + drip (T<sub>1</sub>) resulted in higher canopy area over the surface (T<sub>2</sub>) and surface + drip (T<sub>3</sub>). The canopy area recorded in, T<sub>2</sub> and T<sub>3</sub> was 12.10, 9.0 and 10.50 m<sup>2</sup>, respectively. The highest canopy area recorded in T<sub>1</sub> was due to frequent application of water through microsprinklers during the intercrop period, which resulted in even distribution of the applied water near the root zone. The application of water through drip irrigation during the lean period also improved the water distribution and application efficiency hence more canopy area was recorded in T<sub>1</sub>. The per cent increase of the canopy spread over surface irrigated plants was 34.44 and 16.77% for micro-sprinkler + drip and surface + drip irrigation, respectively. The trend of variation in canopy area among different irrigation methods was more or less similar to that of other vegetative growth parameters. The empirical equations developed for Canopy area in relation to duration from planting are shown in Table 3.

**Table 3:** Empirical equations relating canopy area of litchi with duration

Sr. No.	Treatment	Fitted equation	Correlation coefficient, R <sup>2</sup>
1.	T <sub>1</sub>	$C = -0.0171D^3 - 0.194D^2 + 1.782D + 6.16$	0.990
2.	T <sub>2</sub>	$C = -0.0662D^3 + 0.494D^2 - 0.240D + 7.26$	0.997
3.	T <sub>3</sub>	$C = -0.0165D^3 + 0.1235D^2 + 0.2456D + 6.82$	0.986

C - Canopy area, m<sup>2</sup>, D - Duration from planting, days

The empirical equations (Table 3) were developed relating canopy area with the duration since planting of litchi.

#### *Plant height*

The maximum plant height (288.25 cm) was achieved in case of micro-sprinkler + drip irrigated plants followed by surface + drip (255.87 cm). The minimum (246.12 cm) height was observed in surface irrigation treatment. The analysis of variance of observed data showed that methods of irrigation had highly significant effect on plant height of litchi. The per cent wise increase in mean plant height over surface irrigated plant was 17.27 and 4.06% for micro-sprinkler + drip and surface + drip irrigated plants, respectively (Table 4).

**Table 4:** Empirical equations relating plant height of litchi with duration

Sr. No.	Treatment	Fitted equation	Correlation coefficient, R <sup>2</sup>
1.	T <sub>1</sub>	$PH = -0.028D^3 + 2.00D^2 + 13.19D + 204.1$	0.998
2.	T <sub>2</sub>	$PH = -0.008D^3 - 0.96D^2 + 15.44D + 199.8$	0.998
3.	T <sub>3</sub>	$PH = -0.330D^3 - 3.57D^2 + 21.09D + 198.0$	0.997

PH - Plant height, cm, D - Duration from planting, days

#### *Girth of litchi*

The treatment T<sub>1</sub> produced higher girth of Litchi over T<sub>2</sub> and T<sub>3</sub>. The treatment wise girth of litchi recorded was 29.0, 25.8 and 26.58 cm for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. The difference in girth amongst the treatment was less during initial observations however it increased with the time from planting. The per cent increase in litchi girth in microsprinkler + drip irrigation and surface + drip irrigation over the surface irrigation was recorded as 12.40 and 3.02%. The maximum girth of litchi was attained in microsprinkler + drip irrigated plants because of uniform and frequent application of water at right time during the entire period which resulted in uniform moisture distribution in the soil profile and better utilization of the moisture. The empirical equations presented in Table 5, were developed relating the girth of litchi with time.

**Table 5:** Empirical equations relating girth of litchi with duration

Sr. No.	Treatment	Fitted equation	Correlation coefficient, R <sup>2</sup>
1.	T <sub>1</sub>	$G = -0.045D^3 + 0.407D^2 + 0.252D + 23.17$	0.998
2.	T <sub>2</sub>	$G = -0.004D^3 + 0.055D^2 + 0.509D + 22.38$	0.998
3.	T <sub>3</sub>	$G = -0.012D^3 + 1.143D^2 + 0.415D + 22.48$	0.999

G - Girth of litchi, cm, D - Duration from planting, days

### Shoot length

The shoot length was recorded at an interval of 45 days. The mean shoot length was increased in all treatments from 1529<sup>th</sup> to 1664<sup>th</sup> day from planting after then the overall length of shoot was constant. The minimum shoot length recorded in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> was 25.1, 22.8 and 23.0 cm on 1529<sup>th</sup> day from planting. The shoot length recorded on 1709<sup>th</sup> day from planting was 49.2 cm in T<sub>1</sub>, 34.1 cm in T<sub>2</sub> and 38.1 cm in T<sub>3</sub>, day from planting. The increase in shoot length in T<sub>1</sub> over T<sub>2</sub> was 44.28%. The treatment T<sub>3</sub> recorded 5.57% increase of shoot length over T<sub>2</sub>. The shoot length was significantly affected by irrigation methods.

### Number of fruits

The maximum, 120.5 numbers of fruits was recorded in T<sub>1</sub>. The number of fruits recorded in T<sub>2</sub> and T<sub>3</sub> were 102.2 and 105.6, respectively. The increase in fruit number over surface irrigation was 17.90 and 3.32%, respectively in T<sub>1</sub> and T<sub>3</sub>. The higher number of fruits recorded in T<sub>1</sub> was due to overall better development and growth of plant irrigated under microsprinkler + drip irrigation (Table 6).

**Table 6:** Effect of irrigation methods on number of fruits

Sl. No.	Irrigation methods	Number of fruits/plants
1	Microsprinkler + Drip	120.5
2	Surface	102.2
3	Surface + Drip	105.6

### Conclusion

The treatment based on microsprinkler and drip combination was found superior over surface and

also surface and drip combinations. Silmilar higher yields in horticultural crops were also reported by Sezen *et al.* (2010) and Sharda *et al.* (2011). Desshmukh *et al.* (2014).

The minimum (54.83 cm) depth of water was applied in case of microsprinkler + drip irrigated plots followed by surface + drip (87.07 cm) and surface irrigation (87.31 cm) in ascending order. The water saving in case of microsprinkler + drip and surface + drip irrigation over surface irrigation was estimated as 37.20, and 0.3%, respectively. Thus, maximum saving of irrigation water was achieved in case of microsprinkler + drip treated plots whereas, a small saving of water was achieved in case of surface + drip irrigation method.

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## The Estimation of Income, Livelihood and Productivity from Pulse Enterprise: The Analysis and Implication

Sankar Kumar Acharya<sup>1</sup>, Amitava Biswas<sup>2</sup>, Subham Mandal<sup>3</sup>, Riti Chatterjee<sup>4</sup>, Anwesha Mandal<sup>5</sup>

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### Author's Affiliation

<sup>1,2</sup>Professor, <sup>3</sup>PG Scholar, <sup>4,5</sup>Senior Research Fellow, Department of Agricultural Extension, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, P.O. Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal 741252, India.

### Corresponding Author:

**Sankar Kumar Acharya**, Professor, Department of Agricultural Extension, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, P.O. Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal 741252, India.

E-mail: [ritichatterjee2015@gmail.com](mailto:ritichatterjee2015@gmail.com)

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### Abstract

As a leguminous crop, pulse is the prime mover for ecological health of farm lands which are running under extensive cultivation. It is also one of the most preferred crops in the rain fed agro-ecosystem of Purulia. Specially in a rice-fallow agriculture, pulse is the main source of protein to millions and a dependable mentor of soil health. The present study has been conducted in Manbazar-1 and Purulia-1 blocks of Purulia district and data were collected from 75 respondents who are mainly small and marginal farmers. The selection of the respondents has followed the random sampling method by using an exhaustive list of pulse growers from selected locale. Higher marketable surplus and higher size of homestead land have got the most importance. The study has offered a unique micro level policy implication at a time when the entire Nation is trying to boost up pulse productivity and cultivation throughout the length and breadth of geography of India.

**Keywords:** Ecology of pulse; Marketable surplus; Marketed surplus; Productivity; Regression analysis and yield.

### Introduction

Pulse crop is the most important source of natural protein to millions of people across the world. The role of the pulse is not only confined to our dietary composition, but it also contributes to soil health, moisture retention, livelihood generation, and unshaking important ecological function as well as. Pulse provides the green source of protein to millions of Indian and beyond. In India pulse have been describing as a "poor man's meat and rich man's vegetable". It's a rare type of vegetative protein which retains lysine one of the most important amino acid. As against animal protein, it is the cheaper source of protein as well. Pulse crops require less water and nutrient, less

cost of investment as well. As Indian agriculture cannot fulfill the total pulse requirement due to some difficulties faced by the farmer's, a huge expenditure incurred over pulse import and export.

Pulse is an eco-friendly crop. Pulses are also an excellent feed and fodder for livestock. Pulse crop with its unique ability of biological nitrogen fixation, carbon sequestration, soil amelioration, low water requirement and capacity to withstand changing the climate, pulse have remained an integral component of sustainable crop production system since time immemorial, especially in the dry areas. It adds nitrogen to the soil, retain soil moisture and leave added nutrient for the next crop.

The present study's main perception is income, livelihood and productivity benefits of pulse crops.

Global warming is a harsh reality and returns from conventional crops rice-wheat are dwindling very fast, the importance of pulse crop, both economic and ecological terms is generating both promises and critical acceptance as well.

Food and Agriculture Organization of the United Nations (FAO), the United Nations General Assembly (UNGA) declared 2016 as the International Year of Pulses (IYP).

The study area is basically representing rice based crop ecology, where the pulse is being promoted to replace summer rice. The replacement process is earning critical visions including resource exploitation, marketability, ecological compatibility, social acceptance, and livelihood dynamics. A perception process is generally built up based on one binary aspect- a) Past experience.

The quality perception, better or worse, depends on experience and that is how perception is empirical as well as abstract.

The present study of pulse enterprise, in terms of its selected and predicted characters ( $Y_1$ - $Y_{12}$ ), thus invites a perception of experience on pulse cultivation with the following objectives:

1. To organize a study on socio economic and ecological variables in order to estimate income, livelihood and productivity of pulse enterprises.
2. To estimate the nature, level, and direction of interactive relationships among and between the set of economic and ecological variables as selected for the study.
3. To generate a micro level policy for the improvement in the aspect like income, livelihood, and productivity for equitable and sustainable development.

## Methodology of Research

### *The locale of Research*

Dhanara & Manara GP of the Manbazar-1 & Purulia-1 block of Purulia district in West Bengal was purposively selected for the study. The village namely was Dhanara & Sidpur selected by random sampling. The area has been selected for the study because of - (a) there is sample scope for collecting relevant data for the present study, (b) acquaintance with the local people as well as local language, (c) the concerned area was very easily accessible to the researcher in terms of place of residence, (d) the area was very easily accessible to the researcher in terms of transportation and (e) the closer familiarities

of the student researchers with the area, people, officials and local dialects.

### *Pilot Study*

Before taking up actual field work a pilot study was conducted to understand the area, its people, institution, communication, and extension system and the knowledge, perception, and attitude of the people towards climate change concept.

### *Sampling Design*

Purposive as well as simple random sampling techniques were adopted for the study.

**Table 1:** Sampling Techniques and Sampling Design

Step	Items	Level	Approach
1	State	West Bengal	Purposive
2	District	Purulia	Purposive
3	Subdivision	Purulia sadar	Purposive
4	Block	Manbazar-1 & Purulia-1	Purposive
5	Gram Panchayat	Dhanara & Manara	Purposive
6	Village	Dhanara & Sidpur	Random
7	Respondents	75	Random

### *Empirical Measurement of the Variables*

After reviewing various literatures related to the field of study and consultation with respected chairman Advisory Committee and other experts, a list of variables was prepared.

Variables in the present study have been categorized into two main categories.

(1) Independent variables. (2) Dependent variables.

#### *1. Independent Variables:*

- Age (x1)

In all societies, age is one of the most important determinants of social status and social role of the individual. In the present study, the age of the respondent was measured on the basis of their chronological age at the time of the investigation.

- Education (x2)

Education is instrumental in building personality structure and helps in changing one's behavior in social life. Education may be conceptualized as the amount of formal schooling literacy acquired by the responded.

- Exposure Unit (x3)  
Participation in meeting
- Family Size (x4)  
A number of family members of individual farmers.
- Family labour (x5)  
Family farming is a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on family labour, including both women's and men's. Here the number of family members who attach with the farming was taken as family labour.
- Size of Holding (x6)  
The amount of land owned by a person is an important parameter to access the economic status of the person in society.
- No of fragments (x7)  
It's the number of fragmented lands of an individual farmer.
- Cropping Intensity (x8)  
It has been conceptualized as the proportion of total annual cropped area to the size of holding expressed in percentage. It's calculated as-

$$= \frac{\text{Gross Cropped area}}{\text{Net Sown Area}} \times 100$$

- Home Stead Land (x9)  
The amount of land owned by a person is an important parameter to assess the economic status of the person in society.
- Marketable Surplus (x10)  
The marketable surplus is a term that agriculturalists use to refer to a specific type of surplus that farmers and ranchers deal with. It was taken on the per bigha basis of the individual farmer.
- Marketed Surplus (x11)  
Marketed Surplus as compared to Marketable Surplus is a practical ex-post concept and refers to that part of the marketable surplus which is marketed by the producer i.e., not only the part which is available for disposal but that part which is made available to the market or to the disposal of the non-farm rural and urban population. It was taken on the per bigha basis of the individual farmer.

- Distance from market (x12)  
It's the distance between the market and the field of a farmer.
- Cost of Fuel (x13)  
$$= \frac{\text{Consumption of diesel/Petrol.}}{\text{Electricity in a year}} \times \text{Size of family}$$
- Family Expenditure (x14)  
$$= \frac{\text{Family income in a year}}{\text{Family size}}$$
- Total Cost (x15)  
$$= \frac{\text{Total cost of fuel + Family expenditure} + \text{Expense in pulse cultivation}}{\text{Size of family}}$$
- Crop biodiversity (x16)  
$$= \frac{\text{Total no of crops}}{\text{Size of holding}}$$
- Animal Resource (x17)  
$$= \frac{\text{Total no of animal}}{\text{Family size}}$$

## 2. Dependent Variables

Return from pulse crop ( $Y_1$ ): It is measured in term of Rs/Bigha.

## Result and Discussion

**Table 2:** Coefficient of correlation between Return from pulse crop ( $Y_1$ ) and 17 independent variables (x1-x17)

Independent Variable	r Value	Remarks
Age (x1)	-0.063	
Education (x2)	-0.044	
Exposure Unit (x3)	-0.120	
Family Members (x4)	0.278	*
Family Labour (x5)	0.218	
Size of holding (x6)	0.538	**
Number of Fragments and average size (x7)	0.480	**
Cropping Intensity (x8)	-0.221	
Home-stead Land (x9)	0.379	**
Marketable Surplus (x10)	0.749	**
Marketed Surplus (x11)	0.738	**
Distance From Market (x12)	-0.021	
Cost of fuel (x13)	-0.206	
Family Expenditure (x14)	0.034	
Total cost (x15)	-0.012	
Crop Biodiversity (x16)	-0.325	**
Animal Resources (x17)	-0.154	

Table 2 presents the Coefficient of correlation between the return from pulse crop ( $Y_1$ ) and 17 independent variables.

The following variables have been found to register a significant co-relation with return from pulse crop ( $Y_1$ ) viz, family members (x4), size of holding (x6), number of fragments and average size (x7), home-stead land (x9), marketable surplus (x10), marketed surplus (x11), crop biodiversity (x16).

*Revelation (Table 2):* Return from pulse has gone better for the families having more family members and those having a higher size of holding land. The number of fragments distributed over various topography for the same holding land has offered a better opportunity for pulse crop.

The respondents having a bigger size of home-stead land, more marketable and marketed pulse production have contributed to a higher return of pulse crop.

Since the pulse is followed in a rice-fallow cropping sequence, it has been natured choice for farmers with a low value of crop biodiversity.

**Table 3:** Multiple regression analysis: Return from pulse crop ( $Y_1$ ) with 17 causal variables

Model	B	Std. Error	Beta	t	sig.
x1	-1.989	9.550	-.018	-.208	.836
x2	53.423	27.679	.188	1.930	.059
x3	48.673	45.213	.097	1.077	.286
x4	85.037	112.729	.148	.754	.454
x5	-73.683	110.332	-.092	-.668	.507
x6	67.767	65.497	.241	1.035	.305
x7	-45.573	47.067	-.211	-.968	.337
x8	-1.995	4.479	-.040	-.445	.658
x9	143.098	63.125	.291	2.267	.027
x10	4.895	8.151	.315	.600	.551
x11	6.701	8.782	.411	.763	.449
x12	53.397	32.191	.204	1.659	.103
x13	-.931	1.342	-.127	-.694	.490
x14	-.575	.438	-.510	-1.314	.194
x15	.655	.435	.686	1.503	.138
x16	180.958	267.774	.077	.676	.502
x17	20.489	140.948	.012	.145	.885

R square 65.9%

The standard error of the estimate: 434.307

**Table 4:** Stepwise regression analysis: Return from pulse crop ( $Y_1$ ) with 17 causal variables

Model	B	Std. Error	Beta	t	sig.	
1.	x10	10.848	1.240	.699	8.752	.000
	x9	79.808	39.316	.162	2.030	.046

a. Dependent Variable: Y1

R square 58.5%

The standard error of the estimate: 426.057.

Result: Table-3 and 4 present the full model of multiple regression analysis followed by Stepwise regression analysis.

Table-3 presents that 17 causal variables together have explained 65.9 per-cent of the variance of the dependent variable return from pulse crop ( $Y_1$ ). That indicates that the selected variables for this study have been fairly relevant.

The stepwise regression analysis elicits that two variables marketable surplus (x10) & home-stead land (x9) have come out with stronger determining character on return from pulse crop ( $Y_1$ ).

*Revelation (Table 3 and 4):* The causal effect of higher marketable surplus on return from pulse crop ( $Y_1$ ) is well discernible and higher size of home-stead land here also offers a better indicator for assessing return from the pulse. These two variables have together interpreted 58.5 per-cent of variance embedded with the return from pulse ( $Y_1$ ).

## Conclusion

Pulse is the main source of protein to millions of Indians and cultivation of pulse crop is not economically significant but also ecologically important. It adds protein to the human body, nitrate to soil and resilience to ecology.

The present study has uniquely landed on the value of some important empirical revelation and based on it can be concluded that marketability of pulse crop, along with value addition and branding needs to be enhanced.

The others dimension of the study elicits that both home-stead land and cultivable land, as resources endowed still stance valiant.

Another important thing which comes from the study is that pulse enterprise should be considered a family approach and family enterprise.

Since it's the most dependable provider of protein for the whole family, who otherwise could not effort it by buying it from the market.

This crop has got a big role in stabilizing the national economy by putting up a deterrent to export expenditure in procures pulses from outside India.

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## Managerial Strategies of Farm Animals During Transition Period

D.N. Singh

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### Author's Affiliation

Assistant Professor, Department of  
Livestock Production Management,  
College of Veterinary Science & Animal  
Husbandry, DUVASU, Mathura, Uttar  
Pradesh 281001, India.

### Corresponding Author:

**D.N. Singh**, Assistant Professor,  
Department of Livestock Production  
Management, College of Veterinary Science  
& Animal Husbandry, DUVASU, Mathura,  
Uttar Pradesh 281001, India.

**E-mail:** drdeep25@gmail.com

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### Abstract

The transition period in dairy cows is defined as the last three weeks before parturition to three weeks after parturition, characterized by tremendous metabolic and endocrine adjustments that the cows must experience from late gestation to early lactation. Perhaps the most important physiological change occurring during this period is the decrease in dry matter intake around parturition and the sudden increase in nutrients that cows need for milk production. As a result remarkable changes, most of the infectious diseases and metabolic disorders occur during this time period like milk fever, ketosis, retained fetal membranes (RFM), metritis and displacement of the abomasum (DA) primarily affect cows within the first two weeks of lactation. Physical and metabolic stresses of pregnancy, calving and lactation contribute to the decrease in host resistance during the periparturient period. During two weeks before and after parturition the T-cells populations exhibit a significant decline, which contribute to the immune-suppression in dairy cows at calving leads to increased susceptibility to mastitis and other infectious diseases. Other diseases that are not clinically apparent during the first two weeks of lactation (laminitis, ovarian cysts, endometritis) can be traced back to insults that occurred during early lactation. Feeding and other Managerial strategies during transition period determines the cows productivity during the preceding lactation period. Providing the right nutrition during this period greatly improve the calving ease, cow and calf welfare, milk production and reproductive performance. Careful attention to minimize the depth and length of negative energy and protein balance are equally as important as the provision of adequate calcium, magnesium and phosphorus. Apart from the nutritional aspects, housing is also very important for effective management of transition cows especially to reduce the incidence of the probable complications arising out of metabolic disturbances.

**Keywords:** Down-calver; Endocrine; Ketosis; Laminitis; Metritis; Transition.

### Introduction

Transition period is defined as time frame from 3 weeks before calving to 3 weeks after calving

(Grummer, 1995). It is characterized by tremendous metabolic and endocrine adjustments that the cows must experience from late gestation to early lactation (Drackley *et al.*, 2001). Perhaps the most

important physiological change occurring during this period is the decrease in dry matter intake around parturition and the sudden increase in nutrients that cows need for milk production (Drackley, 1999; Ingvarsten and Andersen 2000). As a result of these remarkable changes, most of the infectious diseases and metabolic disorders occur during this time (Goff and Horst, 1997; Drackley, 1999). Physical and metabolic stresses of pregnancy, calving and lactation contribute to the decrease in host resistance during the peri-parturient period (Mallard *et al.*, 1998). Milk fever, ketosis, retention of placental membrane, metritis and displacement of the abomasum (DA) primarily affect cows within the first two weeks of lactation (Drackley, 1999).

Feeding during transition period determines the cows productivity during the preceding lactation period. Providing the right nutrition during this period greatly improve the calving ease, cow and calf welfare, milk production and reproductive performance. The term transition is to underscore the important physiological, metabolic and nutritional changes occurring in this time frame. It constitutes a turning point in the productive cycle of the cow from one lactation to the next. The manner in which these changes occur and how they are managed are of great importance as they are closely linked to lactation performance, clinical and subclinical postpartum diseases, and reproductive performance that can significantly affect profitability. Transition cow nutrition and management have received much attention in the research and popular-based literature in recent years because of the recognition of its importance in the productivity and health of cows.

### **Biological changes during transition period**

#### *1. Dry matter intake*

**Dry Matter Intake** It is now well established that dry matter intake (DMI) decreases as calving approaches. Dry matter intake can decrease from 2.0% of body weight (BW) in the first few weeks of the dry period to 1.4% BW in the 7 to 10 d period before calving. This 30% decrease in DMI appears to occur very rapidly in the transition period (Bertics *et al.*, 1992; Hayirli *et al.*, 1998; Robinson and Garrett, 1999). During the 3 wk after calving DMI will increase at the rate of 1.5 to 2.5 kg /wk (Grant and Albright, 1995) with this increase being more rapid in multiparous cows than primiparous cows (Kertz *et al.*, 1991; Robinson and Garrett, 1999).

However, individual cow variation in the decrease prepartum and the increase postpartum in DMI is enormous (Vande Haar and Donkin, 1999). The decrease in prepartum DMI has classically been attributed to the rapid growth of the fetus taking up abdominal space and displacing rumen volume. However, there is no doubt that hormonal and other physiological factors have the most important impact on this phenomenon (Grant and Albright, 1995; Robinson, 1997). During the last week of pregnancy, nutrient demands by the fetal calf and placenta are at their greatest (Bell, 1995), yet DMI may be decreased by 10 to 30% compared with the early dry period.

#### *2. Physiological changes*

As the calving approach, blood progesterone level decreases, estrogen level increase. This influence the feed intake of cattle, as a result DMI (dry matter intake) decreases. During the last week of pregnancy, fetal calf and placenta require greatest energy but DMI decreased by 10-30% compared with the intake during early dry period. After calving, for the initiation of milk synthesis and rapidly increasing milk production, high amount of energy is needed. But total intake energy after calving is usually less than energy requirements during transition period. This leads to negative energy balance (NEB). As a result of NEB, suppression of immune system occurs which leads to decrease in immunity and increases the incidence of environmental mastitis during calving. The peri-parturient period in dairy cows is characterized by profound endocrine and metabolic changes to meet out the milk production during early lactation. Increased GH concentration during early lactation stimulates hepatic gluconeogenesis to increase glucose supply. The concentration of plasma insulin continually declines in the transition period until calving and that of somatotropin increases rapidly between the end of gestation and the initiation of lactation. Concentration of plasma progesterone, which is high in gestation, rapidly falls at calving and there is a transitory elevation in estrogens and glucocorticoids in the peri-parturient period. These hormonal changes not only contribute to the decline in DMI, but also coordinate the metabolic changes that favor, if not force, the mobilization of body fat reserves from adipocytes (Grummer, 1995). Resulting from this mobilization of lipids, we observe an increase in concentration of plasma non-esterified fatty acids (NEFA), which rise gradually in the prepartum transition period, but

rapidly in the last 3 day of gestation. A portion of this increase in NEFA is obligatory and is under hormonal control while another portion is the result of an energy deficit (negative energy balance or NEB) (Bertics *et al.*, 1992; Grummer, 1995; Dyk and Emery, 1996). The magnitude of the NEB prepartum, therefore, appears to be a variable that can be mitigated through nutritional management. Additionally, the NEB and resulting increase in plasma NEFA, if sufficiently high, contributes to the development of fatty liver; which itself is a contributing factor to other health problems in the postpartum period (Grummer, 1995; Dyk and Emery, 1996). Rumen Function It is not unusual for a high producing cow in the first 100 d in milk (DIM) to consume 22 kg of DM/d, of which more than half is in the form of concentrates, without posing any particular problems to the cow if the diet is well balanced. However, this same diet consumed by a fresh cow can cause a severe ruminal acidosis. The major difference in rumen function between these 2 stages of lactation can explain the different responses to the same diet. During the dry period, cows generally consume a diet that is principally composed of forages and, by consequence, is more fibrous than the type of diet offered in lactation. This nuance affects rumen function in 2 ways. First, the rumen flora is adapted to a diet that is low in non-fiber carbohydrates (NFC) during the dry period allowing for a large population of cellulolytic bacteria and a low population of amylolytic bacteria. As the amylolytic bacteria also generate lactic acid, their decrease is accompanied by a decrease in the bacteria that utilize lactic acid (Goff, 1999). If the ration is changed abruptly at calving the capacity of the rumen flora to metabolize lactate, the principal acid responsible for acute rumen acidosis, is at a minimum at the initiation of lactation. The lactate producing bacteria increase in numbers rapidly as the amount of NFC in the diet increases, but the lactate-utilizing bacteria adapt more slowly (3 to 4 wk). Therefore, the risk of lactate accumulation in the rumen is high with abrupt changes from high to low fiber diets. Further, it is a known phenomenon that as DMI increases, rate of passage from the rumen increases as well. After calving, when DMI is relatively low, rate of passage is slow; allowing for greater extent of fermentation and acid accumulation in the rumen. If dietary NFC increases abruptly at calving, with high levels of fermentable carbohydrates, the amount of VFA produced far exceeds the capacity of the rumen to absorb them leading to elevated concentrations of VFA in the rumen. This situation leads to the

phenomenon known as subacute rumen acidosis (SARA) and contributes to reduced DMI and feed digestibility as well as laminitis in the early postpartum period.

#### *Immunological Changes and Disease Resistance*

During two weeks before and after parturition the T-cells populations exhibit a significant decline, which contribute to the immune-suppression in dairy cows at calving (Kimura *et al.*, 1999). This immune-suppression during the peri-parturient period leads to increased susceptibility to mastitis and other infectious diseases (Mallard *et al.*, 1998). Other diseases that are not clinically apparent during the first two weeks of lactation (laminitis, ovarian cysts, endo-metritis) can be traced back to insults that occurred during early lactation (Goff and Horst, 1997).

The occurrence of health problems during the transition period is clearly a major complicating factor for subsequent reproductive performance (Ferguson, 2001), resulting in additional economic losses.

#### *Productive changes*

Poor transitions also result in milk income losses. Every pound of milk lost from peak production represents a loss of 200 lb of milk for the lactation. Poor transition periods often result in the loss of 10 to 20 lb of peak milk (e.g., Wallace *et al.*, 1996), which could represent 2000 to 4000 lb of unrealized milk yield. It is, therefore, pertinent to elaborate nutritional strategies to facilitate the passage of the cow through this transition phase; while minimizing health problems and optimizing productivity/ profitability for the remainder of the ensuing lactation. Simultaneously, GH also creates an insulin resistance, which prevents the glucose utilization by the liver, muscle, or adipose tissue and stimulates lipolysis, which mobilizes the fatty acids (mainly non-essential Fatty acids) for milk fat synthesis or used as an energy source to some extent in the postpartum cow. Altogether, the gluconeogenesis-mediated more glucose production and lipolysis-mediated fatty acids are directly available for milk synthesis. Glucose demand is more during early lactation, resulting in hypoglycemic state. Inadequate glucose supply leads to the incomplete or partial oxidation of non-essential Fatty acids, which increases the ketone bodies concentration (primarily Beta hydroxyl butyric acid) during early postpartum period. This excessive blood Non-Essential Fatty Acids and

Beta Hydroxyl Butyric Acid unwanted peripartum complications.

### Common Metabolic Disorders

#### 1. Rumen Acidosis

Excessive acidic pH caused by greater fermentation and acid production by microbes that can be neutralized by the animal. The causes of acidosis are intake of high amount of easily digestible carbohydrate and too little fibre. Acute cause of acidosis is death. Prevention of acidosis is to avoid 'slug' feeding and balanced starch/ fibre fractions of diet.

#### 2. Ketosis

The excessive mobilization of body fat caused by an imbalance between glucose need and glucose supply that leads to a built up of ketone bodies in the body. High demand for glucose (milk production or fetal growth) relative to supply (feed intake) leads to decreased glucose in blood and low insulin. The increase in ketone body concentration comes from beta-oxidation of long chain fatty acids in the liver. Prevention of ketosis is by avoiding over feeding (Fat cows have poor appetite), provide ample amount of well balanced diet and administer Niacin.

#### 3. Milk Fever (Parturient Paresis)

An decreased in blood calcium in response to Calcium drain of lactation causes milk fever. Feed intake drops at calving and the cation- mobilizing system is inactive at calving thereby reduction in calcium in blood and as compensatory mechanism parathyroid hormone and vitamin D try to increase blood calcium but the target tissues are unable to respond to hormonal signals. Symptoms are decreased appetite, staggering, animal recumbent and cold ears. Prevention of milk fever is by feeding low calcium diet and high phosphorus during the dry period.

### Other Health Problems Associated with the Transition Period

The conditions described above favor the occurrence of health problems during the transition period. The principal metabolic problems gravitate around 3 principal axes:

1. Disorders related to energy metabolism (fatty

liver, ketosis, subacute and acute ruminal acidosis).

2. Disorders related to mineral metabolism (milk fever, sub-clinical hypocalcemia, udder edema).
3. Problems related to the immune system (retained placenta, metritis, mastitis).

### Managerial interventions during Transition period

For safe and efficient transition period and to prevent the above said disorders, special managerial interventions in and around parturition should aim at:

- i. Protection against infectious agents,
- ii. Improvement of feed intake,
- iii. Prevention of over conditioning of animal,
- iv. Prevention of lipid metabolism,
- v. Supply of specific nutrient factors and,
- vi. Protection against environmental and managerial stress.

To achieve these objectives following managerial practices need to be followed.

### Drying off the dairy animals

Animals should be given a sufficient time to rest and regenerate mammary tissue, which can be attained by providing a dry period of 45 to 60 days duration (Rastani *et al.*, 2005). The method of complete cessation of milking is a common practice in the low producing cows (<6 kg). In case of high yielders, incomplete milking or alternate day milking for 1-2 weeks followed by complete cessation is an effective method to dry off the animals.

### Dry cow therapy

Dry cow therapy is the treatment of cows at the end of lactation with a long acting antibiotic preparation with or without a teat sealant. This is to treat for any intra-mammary infections contracted during lactation and provides protection against new infections during the dry period. Recently, dry cow therapy is being practiced via two different techniques i.e. use of intra mammary and systemic administration of antibiotics prior to calving. Systemic administration of antibiotics at drying off or some weeks before parturition looks

to be nominal accompanying treatment for intra-mammary therapy, which may be advisable for practice (Ahmad *et al.*, 2015).

### Feeding Management

A decrease in DMI occurs due to the rapid growth of the fetus taking up abdominal space and displacing rumen volume. This decrease ranges from 2% of body weight in the first weeks of the dry period to 1.4% of body weight in the 7-10 days period before calving. This 30% decrease in DMI appears to occur very rapidly in the transition period (Bertics *et al.*, 1992). During the 3 weeks post calving, DMI increases at the rate of 1.5 to 2.5 kg per week, which is more rapid in multiparous cows than primiparous cows. The optimum DMI during prepartum and postpartum should be 1.7% and 2-3% of body weight, respectively. Optimum nutrient and dry matter intake can be supplied by augmenting nutrient density of feed. Therefore, peripartum diet of animal should contain high concentrate and high quality low roughage. Sudden shift to high concentrate diet predisposes the animal to ruminal impaction and metabolic acidosis. The practice of gradual increase in peri-partum diet quantity and quality will acclimatize the ruminal microflora to high concentrate ration without disturbing ruminal ecology. Some experts have suggested that when pre-partum nutrient restriction is followed by increased postpartum nutrient intake, the negative effect of pre-partum nutrient restriction may be overcome partially. However, the effectiveness of elevated postpartum nutrient intake may depend on the severity of pre-partum nutrient restriction (Lalman *et al.*, 1997). Moreover, feed additives such as Propionate production promoters; Propionate enhancers like fumarate (Remling *et al.*, 2014) and malate; Antioxidants (Osorio *et al.*, 2014a); Ketosis controlling agents; Methyl donors like Methionine (Osorio *et al.*, 2014b) and Choline (Grummer, 2011); Monensin (Duffield *et al.*, 2008); Rumen inert fats (Sharma *et al.*, 2016); Rumen bypass protein (Gang *et al.*, 2016); Direct fed microbials (Alzahal *et al.*, 2014); Niacin (Karkoodi and Tamizrad, 2009); Folic acid and Vitamin B12 (Duplessis *et al.*, 2012); Pantothenic acid and Riboflavin (Evans and Mair, 2013) are very much effective in managing the transition stress in dairy animals.

### Housing management

For better feeding and care, the animals in dry period should be separated from lactating animals,

at least 60 days before expected date of calving. This practice will protect the pregnant animals from injuries due to infighting and hence abortion, torsion, dystocia and other complications. Housing of periparturient animals will require the following structures.

#### Dry Animal Shed

Preferably 10 to 15 days prior to parturition, the animal must be transferred to loose housing type shed. Shifting the animals to confined housing on the day of calving instead of earlier, and use of restraint measures at milking increases the somatic cell count, indicates the incidence of mastitis (Svensson *et al.*, 2006). The shed may consist of centrally placed manger with curbs of 0.6 meter length and width per animal under a roof in paddock. The manger should be surrounded by a 2.2 meter wide paved platform with drains. The roofed portion should be 5.6 meter wide and may be gabled. Ties should be provided on the outside of the manger curb at 1.5 meter approximately for occasional use, if required.

#### Down - Calver Shed

The down-calver sheds should have calving boxes for housing those animals very close to calving and standings adjacent to boxes for accommodating those animals heavy-in-calf. A plentiful supply of clean, dry and fresh bedding material on a well-designed comfortable lying surface is a prerequisite in close-up pens (Nigel *et al.*, 2004). The dimension of each calving box should be 3X4 meters with partition of at least 1.2 meter high between the two calving boxes. A manger and water trough, each 0.5 meter wide should be constructed at the rear end of calving box. A single leaved door 2 meter high and 1.2 meter wide should be provided for each calving box. The lower half portion of angle iron frame of the door leaf may be of galvanized steel sheet and upper half of the same may be covered with wire netting the floor of the calving box should be slopped towards the drains.

#### Standings

The standing of the down-calver shed should be constructed with a continuous manger along the wall and provided with tying arrangements so that the animals are tethered facing the wall. The length and width of each standing should be 2.0 and 1.6 meters, respectively. There should be a drain laid on other side of the standing.

## Conclusion

The transition period constitutes a turning point in the productive cycle of the cow since it imposes a number of abrupt changes on the cow which are in 'physiological transit' from one lactation to the subsequent lactations and hence it requires proper management for successful dairy farming. All the concepts of sound nutrition that are important in the pre-calving transition period are equally important in the post-calving transition period. Continued ruminal adaptation to high concentrate diets is critical to control the risk of ruminal acidosis, careful attention to mineral metabolism, as well as energy and protein metabolism, is essential for a successful lactation. Again, the concepts of homeostatic and homeorhetic changes are crucial. Failure to adequately support one area of metabolism will inevitably impact negatively on other metabolic processes. Careful attention to minimize the depth and length of negative energy and protein balance are equally as important as the provision of adequate calcium, magnesium and phosphorus. Apart from the nutritional aspects, housing is also very important for effective management of transition cows especially to reduce the incidence of the probable complications arising out of metabolic disturbances.

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## Influence of Pruning on Yield and Quality of Guava :A Review

Akash Sharma<sup>1</sup>, V.K. Wali<sup>2</sup>, Shilpi Kumar<sup>3</sup>

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### Author's Affiliation

<sup>1</sup>Assistant Professor, <sup>2</sup>Head (Fruit Science), <sup>3</sup>Scholar (Fruit Science), Division of Fruit Science, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, Chatha, Jammu and Kashmir 180009, India.

### Corresponding Author:

**Akash Sharma**, Assistant Professor, Division of Fruit Science, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, Chatha, Jammu and Kashmir 180009, India.

E-mail: [akashskuastj@gmail.com](mailto:akashskuastj@gmail.com)

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### Abstract

The productivity of guava is presently much below the productive potential, due to traditional practices and prevalence of old and unproductive orchards with declining yield efficiency. Moreover, large trees take several years before they come into bearing and overall cost of production per unit area is further increased. The hi-tech and innovative methods which include high planting density have been identified to increase guava production in India in order to be competitive in world market. The response of guava to training and pruning for canopy modification is well known. It is one of the most suitable for high planting density, as it bears on current season's growth and responds to pruning. Modifications in pruning and training techniques influence plant spacing and production decision. Similarly, unpruned tall and crowded guava trees pose a number of problems while carrying out various cultural operations. Guava has a higher proportion of 'shade' to 'sun' leaves and their leaves are found photo synthetically inactive under deeper shade and act as unproductive sink. Therefore, vegetative growth, fruit yield and quality are functions of light interception and translocation of light energy into chemical energy.

**Keywords:** Guava; High density planting; Pruning; Productivity; Quality; Yield.

### Introduction

Guava (*Psidium guajava* L.) is known as poor man's fruit. It is an important fruit crop in tropical and subtropical regions of the country, due to the hardy nature of its tree and prolific bearing even in marginal lands. Among fruits, guava has a very special place owing to its nutrient contents and is known as "The apple of tropics". The fruit is an excellent source of ascorbic acid, pectin, minerals like phosphorus, iron and calcium etc. as well

as vitamins like vitamin A, thiamine, riboflavin, pantothenic acid and niacin (Sharma, 2010). The fruits are in demand in domestic as well as in international market and traded in more than sixty countries. The total production of Guava in India is 3648.2 thousand metric tonnes with an area of 261.7 thousand hectare and productivity is 13.9 metric tons per hectare. In Jammu and Kashmir it is grown in area of 2.46 thousand hectare with a production of 8.65 thousand metric tons (NHB, 2017). At present, guava is cultivated largely through a traditional system, plant takes 5-6 years

for coming into full commercial bearing which increased the cost of cultivation. Land area for fruit cultivation is shrinking due to urbanization and industrialization. Currently, there is a worldwide trend to planting fruit trees at higher density to control tree size and maintain desired architecture for better light interception and ease in operations such as pruning, pest control and harvesting. The system of orcharding having more number of plants per unit area than that is planted under traditional system of planting is called high density orcharding. Increased yield with high density orcharding in guava have been reported by many workers (Bal and Dhaliwal, 2003, Rajput *et al.* 2004). It facilitates to enhance economic production, productivity and quality of fruits and provides efficient use of natural resources. It assures effective use of fertilizers and pesticides as well, which are frequently lost in traditional, wide spaced orchards. Hence, there is overriding need to improve the existing planting system. Therefore, the high density planting system is only one of the ways to increase production and productivity and to minimize the cost of cultivation. The underlying principle of HDP is to make the best use of vertical and horizontal space per unit time and to harness maximum possible return per unit of inputs and natural resources. There are several advantages of high density planting such as early production, high returns per ha, efficient use of fertilizers and irrigation water (Purohit, 1988). The conceptual background of high density planting in fruit growing was pioneered in temperate fruits and first planted at the end of the nineteen sixties, since then there is rise in establishment of commercial high density orchards throughout the world. HDP system is normally understood as a system in which a higher number of plants are accommodated per unit area in comparison to the conventional planting density. However, the exact limit of plant density to be termed as HDP is not yet well defined. It varies with growing region, species, variety, rootstock, agro-techniques adopted for a particular crop and return from the orchard. In India, high density plantings have successfully been demonstrated in guava (Lal *et al.*, 2007). It has been recommended that planting distance for guava should be more in the East-West direction (i.e. between rows) than in the North-South direction (i.e. between plants) as the East-West spread of the trees have a greater bearing (Anon., 1986). Pruning and high density planting in most of the temperate fruit for higher production of quality fruit per unit area has already been taken a lead in major fruit growing areas. However, in tropical and sub tropical fruit the concept of high

density planting is gaining a momentum with the introduction of growth retardants, pruning and training techniques. High density planting orchard may be exploited by managing the plant canopies through standardizing the training techniques.

### Pruning in guava

Fruit tree pruning is the cutting and removing of selected parts of a fruit tree. It spans a number of horticultural techniques. Pruning often means cutting branches back, sometimes removing smaller limbs entirely. It may also mean removal of young shoots, buds, and leaves. Established orchard practice of both organic and non-organic types typically includes pruning. Pruning can control growth, remove dead or diseased wood, and stimulate the formation of flowers and fruit buds. It is widely stated that careful attention to pruning and training young trees improves their later productivity and longevity, and that good pruning and training can also prevent later injury from weak crotches or forks (where a tree trunk splits into two or more branches) that break from the weight of fruit, snow, or ice on the branches. In guava terminal portion of the shoots up to 20 or 30 cm length should be pruned between 20<sup>th</sup> to 30<sup>th</sup> April. Always avoid severe pruning in guava. Pruning the current season's growth of spring flush to avoid the rainy season crop was advocated by Singh (1980). Pruning current season's growth of spring flush to avoid rainy season crop has been advocated in northern parts of the country (Tiwari *et al.*, 1992). The pruning of 25-50% shoots on 20 April, 10 May or 30 May was found to escape flowering in rainy season and encouraged winter season flowering of Sardar guava (Dhaliwal *et al.*, 1998).

### Growth Regulators

Plant growth regulators (PGRs) or phytohormones are organic compounds, other than nutrients, that produced naturally in higher plants, controlling growth or other physiological functions at a site remote from its place of production and active in minute amounts, modify plant physiological process. PGRs called biostimulants or bioinhibitors, act inside plant cells to stimulate or inhibit specific enzymes or enzymes systems and help regulate plant metabolism. They normally are active at very low concentrations in plants. Plant growth regulators generally include auxins, gibberellins, cytokinins, ethylene, growth retardants and growth inhibitors. Auxins are the hormones first discovered

in plants and later gibberellins and cytokinins were also discovered. PBRs are used more extensively in tree fruit production than in any other horticultural or agricultural commodity, and they are essential for effective and profitable production. Several commercial uses have been selected to illustrate the evolution of the involvement of PBRs from infancy to the present and progress made in the fundamental understanding of how regulation by PBRs is achieved.

### **Effect of pruning on vegetative and floral characteristics of Guava**

Sheikh and Hulmani (1997) observed that severe pruning (30 cm) produced the little longer shoot length followed by mild pruning (15 cm) and control in the rainy season of guava plants. Dubey *et al.* (2001) in guava reported that 25 percent pruning intensity produced maximum number of sprouts per shoot as compared to control. Jadhav *et al.* (2002) noticed that earliest emergence of vegetative bud sprout, shoot length, number of flowers per shoot and number of fruits per shoot, on severely pruned (60 cm) trees of guava was found to be significantly more than mild pruned (30 cm) trees. Suleman Mohammed *et al.* (2006) noticed that guava pruning at 60 cm resulted in minimum number of days for sprouting of new shoots, maximum shoot length and highest number of leaves per shoot during rainy and winter season, respectively. Maximum flowers and fruits per shoot during winter season were recorded in 60 cm pruning treatment. Brar *et al.* (2007) observed that the increased pruning intensity in guava increased fruit set and reduced flower drop. Shalini Paliania *et al.* (2010) noticed that 25% pruning of previous season growth in guava gave maximum number of flowers/shoot, maximum fruit diameter under 75% pruning of previous season growth followed by 50% pruning and minimum in control. Kumar and Rattanpal (2010) studied the effect of pruning in guava planted at different spacing under Punjab conditions. The mean tree height was found maximum (5.6 m) in control trees of 6 x 6m spacing and was minimum (4.7 m) in pruning by removal of half the vegetative growth at spacing of 6 x 4 m. Singh *et al.* (2010) reported that pruning intensity at moderate level in high density planting of guava took lowest number of days to 50% flowering, had highest number of panicles per branch and longest blooming period. Moderately pruned trees had the highest fruit yield. Lakhpati *et al.* (2013) reported that Allahabad Safeda under high density planting with three pruning intensities i.e. leaving 10, 20

and 30 cm from base of the shoot and retaining 30, 40 and 50 fruits per tree, resulted in maximum cumulative length of new shoots. Pruning intensity of 30 cm has increased the number of vegetative buds per pruned shoot and number of new shoots per pruned shoot along with early harvesting at color turning stage.

### **Effect of pruning on quality characteristics of guava**

Tahir and Kamran Hamid (2002) conducted the experiment on guava fruit thinning in summer with three treatments viz., control, partial thinning and complete thinning and noticed that completely thinned plants produced highest TSS, total sugars and vitamin-C in their fruits whereas acidity percentage decreased in completely thinned plants. Singh *et al.* (2003) suggested canopy modifications by training and pruning and the need for topping and hedging for having a high density planting system. They recommended a density of 3 x 6 m (555 plants/ha) for the cultivar Allahabad Safeda. Gurudarshan and Dhaliwal (2004) stated that guava pruning at 30 cm produced the maximum fruit weight and fruit size. The increase in terms of length and breadth may be attributed to the reduction in crop load, which in turn diverted more nutrients to the remaining fruits, thereby improving the size of fruits. Gorakh Singh (2011) reported that canopy management under high density planting in guava found highly beneficial towards better tree canopy shape and quality production. Sathya Prakash *et al.* (2012) opined that guava fruit size has direct correlation with number of fruits borne on the trees. Owing to high leaf to fruit ratio and availability of more photosynthates due to removal of current season's growth, the fruits gained larger size and weight compared to those from unpruned trees. The improvement in chemical composition of fruits obtained from pruned trees might be due to abundant availability of photosynthates for lesser number of fruits. Pratibha *et al.* (2013) reported that the plant height was increased in high density planting may be due to unrestricted apical growth. Pankaj *et al.* (2016) studied the effect of pruning severity and plant spacing on yield and fruit quality of guava cv. Pant Prabhat under high density planting and revealed that yield and quality of guava fruits can be influenced by pruning severity. Fruit yield per hectare increased with increase in plant population per unit area. However, chemical qualities of the fruits were found superior at 2.0 x 2.0 m spacing. For obtaining higher winter season crop and enhanced fruit quality under high density

plantation of guava, complete removal of non fruiting shoots followed by one leaf pair shoot pruning of current season growth (i.e. retaining one leaf pair at the base of the newly emerged shoots) should be done during first week of May.

#### **Effect of growth regulators on vegetative and floral characteristics of guava**

Singh *et al.* (1990) reported that use of chemicals like NAA, ethephon, MH, KI and urea caused defoliation in guava. Brahmachari *et al.* (1995) studied effect of foliar spray (one before flowering and one a month after fruit set) of NAA, PCPA, 2,4,5-T, GA<sub>3</sub>, Kinetin and CCC in 6 years old guava cv. Sardar and found that spray of 250 and 500 ppm CCC has enhanced fruit set as well as improved weight and quality of fruit. Jain and Dashora (2007) studied the effect of various plant growth regulators at different concentrations namely, NAA (100 and 200 ppm), Ethrel (250 and 500 ppm), Paclobutrazol (250 and 500 ppm), CCC (500 and 1000 ppm) and triacontanol (5 and 10 ppm) on growth, flowering, fruiting and yield of winter season crop of guava cv. Sardar and found that 60 days after treatment the mean maximum increase in shoot length (36.25%) was observed in 100 ppm NAA treatment whereas, maximum increase in shoot diameter (34.95%) was recorded in 500 ppm PBZ. However, mean minimum days taken to initiation of flowering (29.0), maximum number of flowers/shoots (7.77 /shoot), maximum fruit set (71.17%), highest fruits retention (73.16%) with minimum days taken to harvesting (115.33) and maximum yield (63.83 kg/plant or 17.74 tonnes/ha) were recorded in 500 ppm paclobutrazol (PBZ) treatment. Lal *et al.* (2013) studied the effect of plant growth regulators on flowering and fruit growth of Allahabad Safeda guava under Assam condition and recorded maximum number of flowers (16 per shoot), highest fruit set per cent (93.13) and maximum number (6.2) of fruits per shoot at harvest were found with 1000 ppm CCC treatment and minimum fruit drop (38.8%) and maximum yield (37.1 kg/plant) were recorded under 50 ppm GA<sub>3</sub> treatment.

#### **Effect of growth regulators on quality characteristics of guava**

Brahmachari *et al.* (1995) reported that application of ethrel at 25 or 50 ppm in guava enhanced fruit set percentage, weight, quality of fruit while, reduced number and weight of seeds thereby increased

pulp / seed ratio. Singh and Reddy (1997) reported that all treatments like NAA, ethephon, urea and potassium iodide improved the mean fruit weight of Sardar guava and the maximum fruit weight was observed with 10 per cent urea spray during both rainy and winter season crops. Dubey *et al.* (2002) while studying the effect of various concentrations of NAA (125, 250 and 750 ppm) on quality of guava revealed that treatments, NAA 250 ppm significantly recorded maximum TSS, total sugars and vitamin C contents of winter season guava cv. Allahabad Safeda. Singh and Bal (2006) reported maximum fruit size, TSS and vitamin C content in guava cv. Sardar at wider spacing (6 x 5 m). Fruit weight was maximum in 6x3 m and minimum in 6x4 & 6x2 m spacing. Acidity was minimum in 6 x4 m spacing and maximum in 6x2 m spacing. Pre-harvest foliar application of growth promoters like NAA (100-200 ppm), GA<sub>3</sub> (25-75 ppm) and Triacontanol (5-15 ppm) applications were reported to bring improvement in yield and quality of guava fruits and revealed that foliar application of NAA 200 ppm recorded maximum fruit size (53.14 cm<sup>2</sup>), fruit weight (138.53 gm), specific gravity (1.17 gm/cm<sup>3</sup>) and minimum seed weight (5.19 gm). The quality of fruits in terms of total soluble solids (11.47%), reducing sugar (4.48%), ascorbic acid (239.03 g/100g pulp) and total sugar (7.43%) were also significantly higher with NAA 200 ppm. Datta and Banik (2007) studied the effect of foliar feeding of nutrients and plant growth regulators on physico-chemical quality of Sardar guava and reported that, the maximum length of fruit (6.24 cm), TSS (10.85 °B), total sugars (7.25%) and ascorbic acid (135.420 mg/100g fruit) was obtained with treatment urea + K<sub>2</sub>SO<sub>4</sub> + Zinc + NAA. Garasiya *et al.* (2013) studied the effect of various concentrations of GA<sub>3</sub> (50 and 100 ppm), NAA (20 and 40 ppm), 2, 4-D (5 and 10 ppm) and CCC (250 and 500 ppm) on quality of winter season guava cv. L-49 and found that among all the treatments, NAA 40 ppm gave significantly maximum TSS, reducing sugar, non-reducing sugar, total sugars and ascorbic acid contents in guava fruits. Moreover, an application of NAA 200 ppm significantly reduced acidity (0.20%) (Singh *et al.*, 2017). Singh and Kaur 2018 revealed that ethephon 750 ppm could be used for enhancing the quality characters of guava fruits cv. Sardar. GA<sub>3</sub> 50 ppm proved to be the best in increasing the quality characters like TSS, ascorbic acid and total sugars in both the guava cv. Arka Mirdula and Arka Amulya cultivars (Jayalakshmi and Shakila., 2018).

### Effect of pruning and growth regulators on yield characteristics of guava

Jadhav *et al.* (1998) had reported highest fruit yield of guava cv. Sardar with single pruning 60 cm from the tip on 25 April. Growth and yield characters were significantly influenced by planting systems cum densities viz., square system, hedgerow system, double hedgerow system, and paired planting in guava cv. Sardar under rainfed conditions and the highest yield was recorded in paired planting. The girth and volume of tree showed decreasing trend with increasing tree density while tree height increased with increasing tree density in Allahabad Safeda guava (Kumar and Singh, 2000). Singh *et al.* (2001) studied the effect of pruning dates on yield of Guava cultivars i.e. Allahabad Safeda and Sardar for five consecutive years. The yield during winter season was increased significantly in May and June on pruned trees than the unpruned trees of both the varieties. Dubey *et al.* (2002) studied the effect of various concentrations of NAA (125, 250 and 750 ppm) on the reproduction of guava and revealed that among all the treatments NAA 250 ppm gave significantly maximum fruit set in winter season of guava cv. Allahabad Safeda. Singh and Bal (2002) reported that, under different spacing viz. 6x4, 6x5 and 6x6 m in guava cv. Sardar, the yield per tree and Vitamin C were maximum in closely spaced trees.

The fruit size and weight were maximum in 60 cm pruning treatment during rainy season and in 30 cm pruning treatment during winter season. 60 cm pruning treatment produced minimum yield in rainy season and subsequently maximum during winter season. Increase in plant density markedly increased the plant height while, the basal girth of the plant and spread of the crown decreased in guava cv. L-49 (Kundu, 2007). Singh *et al.* (2007) recorded maximum plant height and trunk circumference, while minimum canopy spread (NS/EW) in closely spaced guava trees (1.5x3.0 m) under closer spacing, increase in height might be due to competition for light because of insufficient space. Mate *et al.* (2009) used plant growth regulators during hasta bahar under Maharashtra condition and reported that, the foliar spray of combination of GA<sub>3</sub> 100 ppm + Etherl 600 ppm + Cycocel 1000 ppm produced highest number of fruits (213.87 /tree), yield (38.29 kg/tree) and percentage of number of fruits (45.43). Foliar sprays of urea 2% + NAA 100 ppm produced maximum fruit weight (198.369 g) and highest yield (95.39 kg/tree) (Katiyar *et al.*, 2009). Jain and Dashora (2010) studied the effect of different

bioregulators in relation to fruit quality and yield of guava cv. Sardar under Rajasthan condition and reported that maximum yield (63.83 kg/tree) was recorded in 500 ppm PBZ treatment. Kumawat *et al.* (2014) reported that the yield of guava fruits can be influenced by high density planting. Higher yield per hectare was obtained with plant spacing 1.0x 1.0 m. Plant spacing caused an impact on fruit yield per plant, as the plant population per unit area increased, yield per plant decreased during both seasons and years. Lower number of flower bud and fruits per plant in closely spaced plants seems to be due to lesser photosynthetic activity, because of exposure of less number of leaves to sunlight, overlapping of branches and reduced fruiting area due to more number of plants per hectare and high competition for nutrient caused lower yield per plant, while higher yield per hectare with close spaced plants may be due to more plants accommodated per unit area in guava.

### Conclusion

- HDP and meadow orcharding gives higher yield as well as returns/unit area due to increasing the no. of trees/unit area. It is possible by regular pruning and use of bioregulators for maintaining the size and shape of the tree.
- Guava planted at spacing 3m x 6m, 3.0 m x 3.0 m and 3.0x1.5 m under HDP and 2m x 1m under meadow gives higher production as well as more income in Shweta and L-49.

### Future Thrust

- There is need to more research on time and intensity of pruning in guava
- Screen the varieties having less canopy area and erect growth.
- Research on PGR for increasing yield and improving quality under HDP as well as meadow orchard system.

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## Herbal the Harvest: The Business Profitability and Ecological Sustenance in India

Dristika Jairu<sup>1</sup>, S.K. Acharya<sup>2</sup>

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### Author's Affiliation

<sup>1</sup>PG student, <sup>2</sup>Professor, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal 741252, India.

### Corresponding Author:

**S.K. Acharya**, Professor, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal 741252, India.

**E-mail:** [acharya09sankar@gmail.com](mailto:acharya09sankar@gmail.com)

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### Abstract

A journey of the agricultural scenario of India from its self sufficiency to it exploring different arenas in order to keep the farming community thriving with promoting the herbal harvest basically the aromatic and medicinal plants. In the light of the schemes like doubling farmer's income by 2020, Aroma mission and Ayush mission a plethora of farming opportunities have arrived which could benefit the farmer and provide him with a consistent amount of returns for his hard work. It is a means of combining the traditional crops with the herbal crop for the sustainability of the farm and the farmer in today's flickering environment of climate change.

**Keywords:** Self-sufficiency; Herbal harvest; Doubling farmers income; Farming opportunities; Sustainability; Returns.

### Introduction

India being an agricultural country, a massive focus was given to the agriculture sector especially after independence where there was a lot of food shortage hence to meet these various developmental strategies were made on raising the agricultural output and improving the food security of a newly independent India. Hence, leading to the massive success of the green revolution and other developmental programs, the food shortage was surmounted with an impeccable success rate. After that, it increasingly multiplied the food production 3.7 times whereas the population multiplied by only 2.55 times. According to these statistics, India has now become not only food self-sufficient at a comprehensive level but is also capable of exporting its agricultural products abroad. This success somehow overshadowed the farmer's plight in India, the earlier development program

neither did focus on promoting the farmer's welfare nor focused on the farmer's income instead all of its attention was deviated just to increase the farm income. With a lot of loopholes and forged assumption the agrarian crisis just got worse as their myopic sight could only see self-sufficiency as the only goal achieved at the cost of the farming communities' agony. But India has come a long way with its policies thereby making it self sufficient and also capable of being the highest exporter of many agricultural produce.

### *A beacon of hope-*

As of now, "Doubling the farmer's income by 2022", a new strategic development program specifically focusing on doubling the farmer's income. To achieve this goal by 2022 as of started from 2015-16 requires annual growth of 10.41 per cent in the farmer's income as per the NITI Aayog.

Therefore, there should be a sharp increase in the farm income, thus, strong measures need to be applied to obtain all sources of growth in farmer's income within as well as outside the agricultural sector. There have been missions like the Aroma mission by the CSIR (Council of Scientific and Industrial Research) that aims to increase the income of the farmers through the cultivation of high value and high demand aromatic crops by about Rs. 30,000 to 60,000/ha/year. About 45,000 skilled human resources capable of multiplying quality planting material, distillation, fractionation and value addition will also be developed under "Skill India" initiatives. More than 25,000 farming families are likely to be directly benefitted and employment of more than 10-15 lakh man days will be generated in rural areas. Scientific interventions would provide assured benefits to the growers of Vidarbha, Marathwada, Gujarat, Rajasthan, Andhra Pradesh and other states where farmers are suffering due to the unsuitable weather conditions and account for maximum suicides and also the National Ayush Mission (NAM), Ministry of Ayush, promoting the ayurvedic medicines thereby affecting the direct production of medicinal plants in our country.

In a generation that keeps exploring different arena's these policies are opportunities that are far and rare ones, leading to an unprecedented path. Hence, it is probably an apt time to lay one's footprint into this arena of herbal harvest precisely the business aspect of medicinal and aromatic plants. Especially for its ease of growing and high profitability. It also provides first-hand therapy against many diseases like arthritis, asthma, diabetes etc, along with the discovery of several new molecules detected in the herbs which are proven to be capable of treating other dreaded diseases like cancer etc, and the relative safety of these products has led to an increase in the demand of medicinal plant products in recent years. Similarly consumers are preferring cosmetics with aromatic products from plants resulting in higher demand for the raw material. India is one of the earliest civilization acknowledging the importance of herbal products, which is by no surprise that it is a niche to almost 8000 medicinal and 2500 aromatic plants.

### Materials and Methods

Descriptive techniques including source resources, editing and sequencing of ideas, citations were followed to develop the text.

An insight into a blooming Business opportunity-

Medicinal and aromatic plants are generally considered as an industrial crop and their products are used in the pharmaceuticals or flavour or fragrance industries. According to the World Health Organization (WHO), nearly 80 percent population in developing countries is dependent on traditional systems of medicine, which are mostly plant-based.

India has nearly 9500 registered herbal industries and a multitude of unregistered cottage level herbal units. Apparently, a plethora of business opportunities have opened up that can solve unemployment problems in rural areas, increasing farmer's income by giving them a better alternative to the traditional crops or even mixed cropping along with the traditional crops, thereby improving rural living standards with a constant income generation all throughout the year and thus enabling India to become a leading exporter of these plants and their products. In context to recent times it is already ranking number two position with regard to export of raw materials but it is in the sixth position when it comes to export of value-added products; and as likely observed by economists export of value-added products would fetch higher profits than the export of raw materials, this most likely enlightens us to the path that we should be trailing on.

The herbal harvest has been led by strong and rapidly growing industrial demand, with some Indian companies like Dabur, Himalaya, Patanjali, etc. leading the forefront, Dabur also conducts special training programs as part of its Environment Sustainability strategy. According to the Govt data, industry estimates put the market of herbal products at 50,000 crores, growing at a fast annual clip of 15%. Acreage devoted for herbal harvest is still very small- 6.34 lakh hectares out of the total currently cropped area of 1,058.1 lakh hectares though it is growing at 10% annually. Also, it's highly advantageous for the farmers because by sowing the herb only once, one can harvest it two or three times a year. This means that the profit margin for the next two times will be higher as the input cost involved will be much lower. The farmers are intended on earning about 3 lakh rupees per acre in comparison to the returns in rice and wheat farming which is not above a 30,000 per acre.

The most commonly found herbs whose value and business perspective was unheard of-

### Results and Discussion

Menthol mint (*Mentha arvensis*) is the source of natural menthol and is widely used in fragrance, flavour and aroma industry. It is quite popular

in the Indo-Gangetic plains among the small and marginal farmers covering an area around 3 lakh hectares. The essential oil yield of 100-150 kg from one hectare is possible after 3-4 months of its sowing.

Improved variety (ies)	Kosi, CIM-Kranti (CSIR-CIMAP)
Cost of cultivation	Rs.40,000/ha
Gross return	Rs.1,40,000/ha
Net profit	Rs.1,00,000/ha

*Aloe vera (Aloe barbadensis)*- It is a high valued medicinal herb which is used in the cosmetic as well as medicinal industry. Indian start-up companies like Naturelo Agro, have business turnovers in crores with the cultivation of "babie densis" variety of aloe vera, on its 120-acre field, which are mainly exported to Brazil, Hong Kong and America.

*Amla (Phyllanthus emblica)*- Also known as Indian gooseberry, it is the only crop used in around 219 medicines in the world, therefore, its medicinal properties are impossible to fathom. It can also be used for the preparation of innumerable value-added products like amla beverages such as squash, syrups and dehydrated amla products like candy.

*Ashwagandha (Withania somnifera)*- It is also known as Indian ginseng. This medicinal herb is known to improve immunity as an adaptogen and also for its anti-cancer properties. Ashwagandha generates about Rs.1,00,000 return per acre, most of which are bought by companies like Dabur, Patanjali, Organic India and export houses. In India, Rajasthan is the highest grower of this herb.

*Basil (Ocimum basilicum)*- Also known as the "Queen of herbs". It has great demand in the pharmaceutical, cosmetic and processed food industries. Furthermore, it can be grown in all types of climate and by investing 25-30,000 rupees in the initial stage of cultivation; an outcome of 3 lakh rupees can be expected in about 3-4 months.

Improved variety (ies)	CIM-Saumya, CIM-Jyoti (CSIR-CIMAP), RRL-OG-14 (CSIR-IIM)
Cost of cultivation	Rs.20,000/ha
Gross return	Rs.60,000/ha
Net profit	Rs.40,000/ha

*Brahmi (Centella asiatica)* - It is one of the traditional and early age herbs of India. It is famously used for improving mental clarity and memory recall concentration. Its cultivation is as profitable as Ashwagandha.

*Damask Rose (Rosa damascene)* - it is a perennial shrub and one of the most important rose species, it is generally grown in high altitude region ranging

from 250 - 2500m About 25-30 q/ha fresh flowers are harvested from the one-hectare area which produces 0.60 kg rose oil. The market price of oil ranges between Rs. 5.0 to 6.0 lakh/kg. After deducting all costs, this crop gives an average net return of Rs. 2.00 lakh/ha, it is used in making rose water, rose concrete and rose absolute.

Improved variety(ies)	Himrose, Jwala (CSIR-IHBT), Noorjahan, Ranisahiba (CSIR-CIMAP)
Cost of cultivation	Rs.1,00,000/ha
Gross return	Rs.3,00,000/ha
Net profit	Rs.2,00,000/ha

*Rosemary (Rosmarinus officinalis)* -it is a woody, perennial herb with fragrant, evergreen, needle-like leaves and white, pink, purple, or blue flower. It can withstand droughts, surviving a severe lack of water for lengthy periods. It can be cultivated in Himachal Pradesh, Jammu and Kashmir, Niligiris and Uttarakhand hilly regions. Rosemary leaves are used as a flavouring in foods and herbal tea.

Improved variety(ies)	CIM-Hariyali (CSIR-CIMAP)
Cost of cultivation	Rs.60,000/ha
Gross return	Rs.2,40,000/ha
Net profit	Rs.1,80,000/ha

*Jatropha (Jatropha curcas)* - Jatropha is one of the best oilseed plants with medicinal as well as industrial usage. The plant prevents soil erosion and can be grown in wastelands with low rainfall or drought-prone areas. And it is widely known as the main source of bio-diesel for an environment-friendly world. Hence, could be cultivated in many drought-prone areas of India.

*Lavender (Lavandula angustifolia)* - Generally, lavender farming is profitable in India but it can be grown in the Himalayan region only. It requires no input except water that too only at the time of planting hence it is highly cost effective. Lavender flowers are processed to obtain oil, dry flowers and other value-added products. The Indian Institute of Medicine has been promoting the cultivation of lavender, rosemary, geranium because the demand for its essential oil has increased tremendously in the domestic market.

Improved variety(ies)	RRL-12 (CSIR-IIIM)
Cost of cultivation	Rs.1,20,000/ha
Gross return	Rs.4,20,000/ha
Net profit	Rs.3,00,000/ha

*Lemon grass (Cymbopogon citratus)* - Lemongrass is one of the commercially cultivated crops in India that is grown at a very wide range. Apart from the medicinal value, it is majorly used in the perfumery,

cosmetics, soaps, detergents and beverages. Total oil produced from 1 hectare of lemongrass farming in one year is generally 480kg, which has a probability of being sold at 12,000 rupees per kg.

Improved variety(ies)	Krishna, CIM-Shikhar (CSIR-CIMAP), Jor Lab-L-8 (CSIR-NEIST)
Cost of cultivation	Rs.40,000/ha/year (irrigated), Rs.30,000/ha/year (un-irrigated)
Gross return	Rs.1,60,000/ha/year (irrigated), Rs. 1,00,000/ha/year (Un-irrigated)
Net profit	Rs.1,20,000/ha/year (Irrigated), Rs.70,000/ha/year (Un-irrigated)

*Vetiver (Chrysopogon zizanioides)* - Vetiver plants are very strong and can withstand extreme heat and cold conditions. These plants are disease free and easy to manage. A farmer is expected to have a profit of Rs.1,00,000 per acre under the cultivation of vetiver, thus increasing the income of the farmer by three to four times, especially, in the Southern states of India. Vetiver oil is useful in the perfumery, soap making and cosmetic industries.

*Safed musli (Chlorophytum borivillianum)* - This plant has excellent ayurvedic properties and can be grown anywhere in the country. Commercial cultivation with good crop management practices will give a good result, hence, many farmers are taking up the cultivation of this high investment crop. It is used in the preparation of general health tonics and is also one of the important ingredients of Chyawanprash. It can give a profit of about Rs.1,00,000 per acre from the second year of planting.

## Conclusion

A boon to explore further...

There are indeed vast multifarious herbs to be mentioned which have extraordinary properties and which can be used as a successful business venture for an Indian farmer in particular and the whole farming community in general. Therefore, such a lucrative business idea with healthcare benefits, sustainable economy, environmental protection and ecological restoration is worth exploring. Millions of livelihood can also be created to ensure minimum income support for those surviving hard in eking out livelihoods across the geography and economic terrains.

“Farming is a profession of hope”

-Brian Brett

Let's hope for a wealthier farmer, a prosperous nation and a better world.

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