

Review Article

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## Climate Change and Mixed Crop Livestock Farming Systems in Developing Countries: Importance and Impacts

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### ABSTRACT

Crop production and livestock both are most important aspects of agriculture. Because in farming systems based on mixed crop livestock the waste or by product of one system is used as input to second system. Soil-fertility depletion in smallholder farms is the main biophysical process explaining the impact of climate change on decline in per capita food production. At farm scale, however, it becomes evident that the set of processes leading to soil- fertility depletion is not homogeneously distributed in space. Variability in soil fertility arises from differences in underlying geology and geo-morphology, and due to a number of mechanisms within the farming systems (i.e. farm management practices). Farmers manage several organic and mineral resources in order to attain their production goals. The net flow of resources is not equal for the various fields belonging to a single farm household but varies substantially, creating areas with carbon and nutrient accumulation and depletion. Some of the nutrient flows and transfers involved vary strongly between farmers of differing social status, notably between cattle owners and non-cattle owners. A differential long-term management of the different fields of a farm adds an important source of variability, creating zones of soil fertility due to concentration of agricultural produce and organic wastes around the homesteads under changing climate.

#### Keywords

Mixed crop,  
Livestock, Climate  
change, Soil fertility,  
Food production

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### Introduction

Climate change will change in the farming systems existing in developing countries like India. In mixed farming systems, both crop and livestock are working together. Mixed farming is act as the backbone of small farmers in the country as well as in the developing countries of the tropics. Mixed crop livestock play a greater role in the

developing countries. The economic status of the people living in developing countries still earning less 100 rupees per day globally which are around 1.2 billion across the global level and most of them are living in tropical countries likewise India and others nations. In developing or under developed countries food security is the crucial issue to maintain livelihood. Because climate change is affecting existing farming systems in many

ways due to changing in the climatic factors like intensity of rainfall, duration of rainfall, increase in mean daily, mean monthly and mean annual temperature, which affects sustainability of human life. Because half of the global population are engaged in mixed farming systems and their food crops are coarse cereals, starch crops and other tropical food crops. Still current and future impacts of climate change on mixed farming systems have not been extensively studied. The agricultural crops and their related farming systems are under productivity level i.e., the production of crops are decreasing by reduction in productivity of crops. The reduction in productivity may be due to crops existing mixed farming systems are susceptible to changing climatic scenario. The existing mixed livestock farming systems in developing countries based on existing ecological regions are rainfed mixed crop-livestock systems in arid-semiarid regions, rainfed mixed crop-livestock systems in humid to sub-humid regions, irrigated mixed crop-livestock systems in tropical high land etc. The predominant mixed livestock farming systems in developing countries are mainly based on the availability of water through rainfall and other irrigations sources.

These regions mostly covered with two basic farming systems which are rainfed and irrigated mixed farming systems. In India rainfed mixed crop-livestock system, irrigated mixed crop-livestock systems are mostly dominant in the humid, sub-humid and temperate regions of the country. The farming systems includes a variety of systems based on availability of farm resource, existing climatic condition and many other factors like economic status of farmers, suitability of crops and their cultivars, type of livestock found in a particular region and finally social factors. Social factors are not dominant much, but in India social factors are the major concerns for us like Sikh peoples do not use

tobacco and also not cultivate tobacco crops. Indian farming is basically a subsistence type of farming.

### **Importance of the mixed system**

Mixed farming systems are kind of subsistence farming systems prevalent cross the global level in developing countries. These systems provides most of the staples consumed worldwide specially cereals. The production of cereals like rice (86 %), maize (41%), sorghum (66%), 75 % of millets production directly comes from these crop-livestock system. The importance of such mixed systems are given in the following-

Backbone of small and marginal farmers

Major source of livelihood security of farmers

Mostly dominant in developing tropical countries

Cropping with livestock is most popular among small farm communities

Provides nutritional security to farmers family

It covers 2.5 billion hectare of land globally

Largest category of livestock systems

Produced 92 per cent of the world's milk supply

Supply 70 per cent of small ruminant meat

The waste products of one enterprise can be used by another enterprise

Crop-livestock systems are widespread in all agro-ecological zones

These are dominant under lowlands to highlands

Irrigated rice, pig and poultry enterprises dominant in Asian continent

These systems produced nearly 50 per cent of world's cereals

They provides staples consumed by poor peoples

Less risk of system failure

Major source of income for marginal and small farmers

Unskilled farmers and workers get employment

All daily and basic requirements are completed at farm levels

### **Impacts of climate change**

The climate change is the global issue now a day. It has various impacts on all living and non- living organisms at different levels of climate such as at micro and macro levels. The climate change has greater importance in plant growth and development because the grain yield production of crop plants is totally dependent on various factors of climate, plant and soil. There are almost 52 factors controlling the yield potential of crop plants, among them 45 factors are under the control but remaining 7 factors beyond the control of management which are highly determinative of crop yield. Because of climate change such factors are changing day by day and creating unsuitable conditions for proper plant growth and development like increased temperature and concentration of various atmospheric gases such as carbon dioxide and other gases. The rate of photosynthesis is increasing in some plant types and decreasing in other crop plants because of suitability and unsuitability of rainfall, solar radiation, air temperature, and composition of various gases specially

carbon-dioxide changing due to climate change. In some experiments it was shown that productivity of oilseeds like rapeseed and mustard will increase i.e. climate change has positive impacts on plant growth and developments which leads to increased yield and higher percentage of seed oil content production per unit area and time. The climate change not only having impacts on crop plants but it also has positive and negative impacts on livestock production. The negative impacts of climate change will change in animal growth and productivity. It will change in milking ability of dairy animals such as cow and buffalo, meat production capacity of buffalo, pig, horses due to increase in temperature sensitivity i.e. higher temperature during summer and very low temperature during winter season or higher average mean monthly temperature during winter.

During both the summer and winter seasons, fluctuation in temperature, rainfall and relative humidity which leads to create abnormal situation in habitat and habit of the livestock. The abnormal weather leads to high rainfall which creates flooding, drought situation and affects the livestock due to reduction in animal feed supply and availability. The potential impacts of climate change on crops and livestock in different pockets of worlds are vary from country to country due to variation in the mixed farming system types and management practices as well as various climatic factors affected by topographical situations like lowland or highlands. The major impact of climate change will change in the productivity of various crop plants specially C<sub>4</sub> plants. Impact of climate change will be severe in the tropical countries. The productivity of maize is 10-30% decreasing in the sub-Saharan Africa countries by the middle of 21<sup>st</sup> century. The impacts of climate change will be vary from region to region from 10- 40 % on

productivity of maize and bean crops due to increasing temperature.

### **Impacts on crop and land based livestock**

#### **Direct impact**

Extreme weather events: The weather abnormality i.e. higher or lower rainfall, snow fall, thunder storms with high wind velocity will destroyed plant specially at harvesting stage and loss of animal life.

Drought and floods: Because of higher rainfall creates flooding situation all over the regions and leads to breaking of dams, pond and large water reservoirs and silting of water bodies. The silting of water bodies will shallow the water storage structure and reduce the water storage capacity. That further leads to scarcity of drinking water for both human and animals, and irrigation water availability to crop plants.

Loss of productivity of crop and animals due to increased temperature: The climate change leads to increase in temperature that affects crop and animals at different levels like reduction in plant growth, reduced height, early maturity will cause reduction in grain yield or dry matter production and also reduced age of puberty, milking duration and finally reduced milking ability. The climate change will reduce productivity of both plant and animals.

Depletion of ground water table will increase cost of ground water pumping by tube wells for irrigating crops and drinking water for animals

#### **Indirect impacts**

Quantity and quality of food grains  
Quantity and quality of fodder  
Host plant interactions

### **Impacts on non-grazing livestock**

Water availability

Abnormality of weather

Increased resource price (feed and energy)

Disease epidemics

Increased cost of animal housing (cooling system)

The mixed crop livestock systems of the tropics are most important for a large number of peoples food security and many of them are belongs to vary poor background. The future role of the smallholders in total food grains production and security of food in the 21<sup>st</sup> century and coming decades will not be certain due to changing climate scenario and so many economic and social factors specially growth of global population because most of the world's population belong to developing countries in tropical parts. Change in climatic pattern will be responsible to change in animal and plant species and diversification will be more, that change will also uncertain.

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