Chapter 2

ECONOMICS OF AGRICULTURAL DIVERSIFICATION

2.1. Introduction

Agricultural diversification is a socioeconomic process whereby farm households engage their resources in multiple activities under a specific farm enterprise or across several enterprises over time. It is recognised by research authors that agricultural diversification has multiple facets, each of which relate to the rationality of agricultural diversification, and to the impact that agricultural diversification has on agricultural income and risk. Diversification can thus either be viewed as a strategy for income maximisation or risk minimisation or both. These two dimensions draw from the economic agent's resource allocation decisions made under the assumption of perfect knowledge corresponding to which the positive aspect of agricultural diversification is associated. However, because such an assumption is rarely fulfilled in real world situations, diversification can also be regarded as an optimising strategy in situations of imperfect knowledge and uncertainty corresponding to which the normative aspect of agricultural diversification is related. Besides making a separation between such *positive* and *normative* aspects in agricultural diversification, it also becomes necessary to contextualise the different standpoints described in the literature. This review of literature has been grouped under the broad research themes that recur within the literature to bring out their relevance to the context of the present study and for analysing the literature meta-synthesis technique is pursued.

2.1.1 Agrarian Relations and Rural Livelihood

The right and access to land is of critical significance for rural people in the developing countries, and the entire socioeconomic as well as political networks revolve around it. Farming based on land and other natural resources is the primary source of their livelihoods and a basis for their larger well-being. However, the class structural differences in resource endowments among rural people produce distinct effects on their livelihoods and impede further improvement. In the contemporary literature of capitalism and agricultural development agrarian issues are raised on classical agrarian question related to the capitalist transformation of agriculture and its many trajectories and distributional consequence, and on the economic roles that agriculture should play to serve the development of the rest of the economy, during the agrarian transition (Harriss-White, 2008). Bernstein has argued that the classical agrarian question on the continuing existence of obstacles to an unleashing of accumulation in the countryside itself and more generally has already been solved or bypassed in most of the world because of largely vanishing of predatory landed property after 1970s (Bernstein, 1996; 2006). Hence, in twenty-first century, what remains as the agrarian question is essentially the agrarian question of labour (*ibid.*). However, the development of capitalism in agriculture is a complex process concurrently involves multiple social institutions, which varies over time and space (Harriss-White *et al.*, 2009; Prota & Berestford, 2012). The existence exchange labour system as well as semi-feudal modes of land organisation and tenure in the study region tends to limit the gains from farming.

From a political economy perspective, the agrarian questions on India's agrarian change address the extent of capitalism developed in countryside through process of class differentiation within peasantry, the obstacles of dynamic development, the contribution of agriculture to overall capitalist accumulation and development, and the position of rural labour in such changes (Lerche, 2011). The eco-fragile environment and topographical tightness and thereby limited social and physical infrastructure have created additional obstacles for dynamic development in mountain regions. Historically peasant movement and uprising have taken place in multiple regions within India as the economic policies

devastated traditional ways of livelihood, and resulted in land seizure and increase in debt of the peasants and farmers. The emerged political insurgency for political identity among many Indian communities in multiple regions further deteriorates their people's livelihoods. Hence, the agricultural and rural development in the study region deserves special attention at the outset: the ecological specificities in mountain agriculture; the institutional complexity underlying the use and access to different production forces such as land and labour; and the historical role of the state as the prime mover of agricultural transition.

2.1.2 Agricultural Intensification versus Agricultural Diversification

Agricultural intensification and diversification are the two most widespread adaptation strategies of rural farm households (Warren, 2002). However, these two responses are not mutually exclusive, since contemporary agricultural practice can include elements of both or shift from one to the other in different time points (*ibid.*). Agricultural intensification refers to increasing use of non-land inputs such as labour and capital on land for raising land yield rates, best suiting the agro-ecological conditions of the region as well as the farm and existing market outlets (Tiffen *et. al*, 1994; Hussein & Nelson, 1999). Thus, agricultural intensification often replaces traditional crops or agricultural commodities with new high-yielding varieties, and thereby it requires improved technology (Warren, 2002, *op. cit.*).

Sometimes intensification leads to an initial diversification when farmers apply new varieties of seeds and technologies in traditional agricultural commodities mix for experiment. After successful experiment, farmers may decide to commit greater amount of farm resources to the new and more productive variety. Hence, agricultural intensification may lessen farm diversification and lead to some form of long-term specialisation (Pinghali & Rosegrant, 1995). Agricultural development through agricultural intensification strategy may not be feasible in mountain regions because of their physiographic and agroclimatic situations as well as resource impoverishment of hill farmers as consequences of low crop-yields. In the long run, intensification might not always be compatible with sustainable mountain farming.

Agricultural intensification does not always result in mono-cropping. Most small-farmers have undertaken agricultural intensification technology and knowledge to operate integrated farming systems, which continue to keep a significant degree of diversity (Dixon *et al*., 2001). Agricultural intensification with farm integration makes small farmers' livelihoods viable to cope with risk and uncertainty and market economy. However, many small farmers avoid to practise agricultural intensification because of increased costs of cultivation with high yielding inputs as well as loss of competitiveness when capital intensive agriculture is widely applied in the world food market (*ibid*).

2.2 Theoretical Approaches in the Literature

2.2.1 Strategic Diversification

Livelihood diversification is defined as the process by which rural families construct a portfolio of diverse activities and social support capabilities in their struggle for survival and for the improvement of their standards of living (Ellis, 1998). Through livelihood diversification, rural households thus search for the synergy between poverty reduction, economic development and environmental sustainability (Ellis, 2000a; Lee and Barrett, 2001; Ellis and Freeman, 2004). However, Diversification does not have equal bearing on rural incomes overall, rather it is a heterogeneous social process that occurs for different causes and produces distinct effects over space, so for analysing diversification the importance of local context and local policies must be prioritised to address local circumstances. Agricultural development plays crucial role in both rural and economic development by generating regional diversification and growth (Afifudin, 1974) and also by creating growth linkages between the farm and non-farm sectors (Johnston & Kilby, 1975; Mellor, 1976; Hazell & Roell, 1983; Harris, 1987; Hazell &

Haggblade, 1993). Agricultural development is thus a precondition for rural development in India (Kurien, 1990). The slow pace of industrialisation in the 1990s has accompanied a decline in rural non-farm employment and rising income disparity in rural India. Sluggish growth in the demand for non-farm products has compelled the Indian Government to take new initiatives to boost the rate of agricultural growth (Sekhar, 2002).

The process of diversification combines the tasks of risk-management and crisis-management within the *survival strategy*. Thus, besides being able to produce or procure food in sufficient quantities, the rural poor also have to diversify their income sources in order to survive (Zoomers & Kleinpenning, 1996). As a survival strategy, diversification is more of a sociological process than an economic process, since it describes the micro-social responses of the poor when they have to cope with and survive critical situations, such as a fall in product prices and natural hazards or disasters (Haan & Zoomers, 2005). In absence of stable labour markets which cater to non-farm activities, higher work-participation rates [WPRs] along with a rising number of work-activities per worker have to be derived from within agriculture (Basant, 1993). Diversification not only enables the rural poor to earn enough to survive, but also has a broadly equalising effect on rural incomes (Haggblade & Hazell, 1989; World Bank, 1990; Valentine, 1993; Adams, 1994). Diversification is not merely witnessed in rural societies or in developing countries. As a survival strategy, diversification is also increasingly seen to occur among the urban poor in developing countries (Moser, 1998) and among farm families in developed countries following the removal of their agricultural support systems (Hearn *et al*., 1996).

For rural farm families, the process of agricultural diversification is closely associated with their livelihood diversification. The real cause for poor economic performance of the agricultural sector in developing countries is the low scale provision of economic incentives to farmers rather than their natural adversity and farmer-perversity (Schultz, 1964). In fact, developing countries can attain agriculture led sustainable economic development through diversification into high-value crops in which they have major economic potential (Mellor, 1976 *op. cit.*; 1996 *op. cit.*). Combining with population growth, the inability of such countries to generate commensurate non-farm employment opportunities for their growing labourforce puts substantial pressure on land resources and consequently results in further marginalisation of landholdings. Agricultural diversification in favour of more competitive, high-value, and labour-intensive commodities is recognised as an alternative way to raise income, besides the traditional ways of increasing income through augmenting yield, area, and cropping intensity. Moreover, through such diversification process it is also possible to overcome many of the emerging agricultural challenges like decreasing holding-sizes, deceleration of technological advances in staple crops, dwindling agricultural investment, and over growing degradation of natural resources. The entire gamut of potential income-earning activities can be dynamised by adoption of appropriate technologies within a mixed farming system that thence offers a feasible and economically viable solution to the problem of low income potential of poor farmers (Saini & Singh, 1985). In a macro sense, agricultural diversification is also related to the phases of structural change within agriculture, whereby farmers who had grown subsistence crops at the initial stages of development, attempt to expand production-base and maximise total farm output to match increases in human population, and then diversify agricultural activity again to reinforce the levels of development attained (Chand & Singh, 1985).

To counter the production uncertainties and market-induced risks farmers in rain-dependent agriculture adopt agricultural diversification as a risk-management strategy (Jha, 1997). Nevertheless, the cereal-based and self-sufficiency-oriented activities of marginal and small farmers lead to low value addition, and thereby they cannot adopt capital-intensive technology for which additional resource requirements are high (Jodha, 1986). In such instances of wealth and capital constraints and market-induced risks, diversification helps in stabilising farm incomes, and thus makes a strong case for farm diversification in Indian conditions (Gupta and Tewari, 1985). Agricultural diversification towards high-value cash

crops through utilising local environmental niche is considered as an economically viable strategy for stabilisation and augmentation of farm income, generation of employment opportunities, and conservation and improvement of natural resources, especially soil and water (Vyas, 1996). In the context of deceleration of agricultural growth and stagnation of income in rural India in post Green Revolution regime, agricultural diversification is viewed as an alternative strategy having in-built capacity to sustain natural resource, maintain environmental quality, and stabilise farm income (Rao, 2003) as well as a panacea to reduce rural poverty through provision of economically viable option at farm level in the presence of strong vertically integrated infrastructure, specially marketing linkages in rural India (Kar *et al.*, 2003). As within the decrease in diversity in the production patterns, variability in the gross value of production increases (Singh & Sidhu, 2004). Agricultural diversification is thus treated as a key strategy for sustainable agricultural development because of its ability in minimising production risk, increasing agricultural productivity, stabilising and enlarging farm income, maintaining food and nutritional security, generating employment, eliminating poverty, and keeping up environmental quality through judicious use of farm resources depending upon the available opportunities and managerial skill of farmers (Mustapha *et. al*., 1985; FAO, 2001a; Singh, 2001). But farm level diversification may differ from aggregative state or country level diversification, since even if the farms in different agroclimatic regions specialise in certain products on the basis of comparative advantage, the aggregate resource allocation into agricultural products may still reveal diversification (Acharya, 2003).

Moreover, as a strategy agricultural diversification is able to realise the gains of complementary relationship or by equalising substitution and price relative for competitive produces (Hazra, 2003). In fore of natural risk, the farmers in the risk-prone areas have devised their own coping mechanism in terms of self-provisioning on the one hand and diversification to supplementary and complementary enterprises on the other (Vyas, 2004). The complementary and supplementary roles played by animal husbandry and crop-farming within a mixed farming system are thus seen to support agricultural and rural transport operations through the provision of draught power, while also providing organic manure for maintaining soil fertility (Acharya, 1992; Bhalla, 1993), and thereby as a risk-coping strategy diversification into livestock-related activity in such systems acts as a cushion against risk and uncertainty in crop production, in addition to increase in income and employment of the rural poor (Rao & Birthal, 2003).

2.2.2 Adaptive Diversification

Adaptive strategies seek to spread risk of consumption failure to anticipated adverse trends, and may be manifested either by livelihood intensification or by diversification. Adaptations thus reflect adaptive capacity of the households to deal with problematic exposures and sensitiveness of their livelihoods (Smit & Wandel, 2006). Thus, the capacity to adapt is of critically significance for the adaptation process, which depends upon asset-base, and can be identified and measured at various scales, from the individual to the nation (Adger & Vincent, 2005). However, household-level adaptations need to respond to multiple variables which originate at higher political levels, since for resilience building households have to depend on several organisations through which they address the socio-ecological uncertainty, encompassing both environmental variability and eco-political drivers (Marschke & Berkes, 2006). Although the term 'adaptation' is increasingly used to refer to continuous processes through which resilience is built during climate change, it is not a mere response to climate change (Sabates-Wheeler *et al.*, 2008).

Generally diversification as a form of adaptation is negative, since in this process livelihood is changed to support a lower quality of life than that was previously possible (Bernstein *et al.*, 1992). Rural households have become vulnerable to food stress because of multiple pressures of population on natural resources and their increased dependence on the market. They adopt adaptive strategies to ensure survival in the context of annual gap between cereal production and consumption needs (Davies,

1996). However, this form of adaptation is often involuntary because of survival necessity of the households as well as irreversible. Such diversification process incorporates a change in portfolio of activities for lower and more vulnerable level of existence, and thereby it does not contribute to sustainable livelihoods (Cekan, 1992; Hussein & Nelson, *op. cit.*). The process of adaptive diversification however may be positive, functional and sustainable, and may lead to sustainable livelihoods (IISD, 1996).

As an adaptation strategy diversification helps the farm households in stabilising income and in reducing risks related to climate change (Aerts *et al.*, 2008). Additionally, this assists them to identify land use patterns that are less vulnerable to climate change. Nonetheless, a sustainable livelihood comprises the capabilities, assets, and activities needed for a means of living, which enables the people to maintain or improve their living standard by reducing their vulnerability to external shocks and trends, and ensures their activities (Chambers and Conway, 1992). This can cope with and recover from shocks, and can maintain or enhance households' capabilities and assets without undermining the natural resource-base (Jones & Carswell, 2004). However, climatic variability raises the vulnerability of livelihoods of small holder households and lessens their ability to deal with risks, shocks, and stress (Prowse, 2008). Hence, to cope with the change in the magnitude and frequency of stresses and shocks, multiple approaches such as social protection, disaster risk reduction, and climate change adaptation are needed to booster local resilience and supplement people's experience (Davies *et al.,* 2008). Under this circumference rural farm households adopt non-farm diversification, on-farm diversification as well as migration as adaptive strategies (Ellis, 2000a; Hunter *et al*., 2011). In variation to livelihood assets, different groups of households differently pursue multiple adaptation strategies such as growing of drought tolerant crops, increasing wetland cultivation, and diversification to non-farm activities (Lyimo & Kangalawe, 2010). Since, climate change could have negative consequences upon agricultural production systems, new initiatives have to be undertaken to build resilience into agricultural systems through crop diversification (Lin, 2011).

Climate change is likely to affect the development process along with adaptation processes through potentially widening inequalities in well-being by creating winners and losers (Kates, 2000). However adaptation to climate change results in alarming dilemmas of justice, many of which acutely prevails in communities whose livelihoods are primarily dependent on natural resource in the developing countries (Adger, 2003). Developing nations are often regarded to be more vulnerable to the effects of climate change than developed nations (Smit & Pilifosova, 2001).

The diversification process also occurs to overcome risk and seasonality in natural resource-based livelihoods, while it reflects the increasing inability of agriculture to support improved livelihoods in the post liberalisation era (Ellis & Allison, 2005). Thus, diversification here refers to the continual adaptive process whereby households add new activities within existing ones or drop others, and thereby maintain diverse and constantly changing portfolio of activities *(ibid.).*

2.2.3 Factors in Diversification

Factors in diversification are general incentives and pressures that lead the households to diversify their livelihoods. The literature defines a wide range of motives, goals and pressures under which diversification is seen to occur and also observes that it can take diverse forms to different households. Thus while larger landowners diversify to accumulate, the landless or near-landless diversify to survive (Hart, 1994). Households diversify their livelihood to realise the goals of either maximisation of income or minimisation of risk or stabilisation of income or other (Lee & Barrett, *op. cit.*; Ellis, 2000a, *op. cit.*) under distinct possibilities of necessity or choice that is sometimes posed as being a conflict between survival and choice (Davies, *op. cit.*) or between survival and accumulation (Hart, 1994, *op. cit.*).
Livelihood diversification is generally regarded as micro-level response to risky environment as well as to economic opportunities (Francis, 2000). Ellis (*1998, op. cit.*; 2000b*)* distinguishes between pull and

push factors necessitate for diversified activities. Pull factors act as incentives that afford households to choose multiple income earning activities when they are attracted by more remunerative one, such as commitment of farm resources to floriculture. Push factors are however, constraints that compel the households to involve in multiple income earning activities for survival rather than choice when their existing one or two activity is insufficient to meet their daily needs (*ibid.*). Pull factors to diversification incorporate economies of scope arising from strategic complementarities between activities such as crop-livestock integration, endowment with superior skill and technology by the households as well as community engines of growth such as urbanisation which generates markets for goods and services (Malunda, 2011). Push factors to diversification include rapid population growth and the related pressure on natural resource-base, declining farm productivity and returns to farms, limited access to farm input markets and rural credit markets as well as temporary events such as price volatility in the commodity markets and permanent shocks (Davis & Pearce, 2000).

Generally, the poor households diversify their livelihoods by conditions of push factors. When land becomes scarce and agricultural productivity reduces or when income of the households fluctuates, participation in multiple income earning activities is the only imperative for their survival. The poor households as risk-averse economic agents sacrifice high return for low stable income diversify many low-return but low-risk activities (Dercon, 2005). Under such circumstances, farm households may shift their livelihoods from farm to non-farm activities (Bryceson, 2002).

The availability of assets such as land, labour, education, savings, access to market, employment opportunities, social capital and other public goods is a primary factor in household's livelihood diversification (Dercon & Krishan, 1996b). Opportunities to diversity vary among the households (Mutenje *et al.*, 2010), with differences in their resource endowments and access to markets and institutions. The skills, location, capital, credit and social connections of the households play critical role in their participation in other activities and thereby the extent of their livelihood diversification (Hussein & Nelson, *op. cit.*). Proper asset combination is also critical for the households to follow such diversified livelihood choice (Barrett *et al.*, 2001). Households may also pursue diversification as a coping response to the loss of their capital assets needed for undertaking conventional on-farm production.

The agricultural commercialisation process also leads to diversification, since by widening and integrating rural markets for manufactures it results in reorganisation and resource-reallocation within traditional rural industries in a manner that stimulates technological change. The process makes it easier for new products from urban areas to penetrate rural markets and bring about changes in the consumption patterns of rural areas (Vaidyanathan, 1986).

2.2.4 Determinants of Diversification

Among the determinants of diversification the principal are seasonality of agricultural work, labour-market fragmentation, credit market imperfections, risk-strategies, and coping behaviour as well as intertemporal savings and investment behaviour. All rural households confront of seasonality as an inherent feature in their livelihoods (Chamber *et al.*, 1981; Sahn, 1989; Agarwal, 1990).Work-seasonality continuously mismatches household consumption needs with uneven income flows and thus explains many of the subsequent patterns at rural income diversification, particularly those that involve on-farm diversification of activity and off-farm wage earnings. Combined with work-seasonality, the risk and market imperfections that abound in the rural economy and agricultural environment accentuate income instability among rural households (Ellis, 1998, *op. cit.*). Risk is thus often viewed as the primary motive for income diversification (e.g. Bryceson, 1996), since when households prefer to smoothen their consumption over time and are relatively risk-averse, they accept lower economic returns as long as there is greater security and lesser risk. With experiencing crop or market failure, farm

households diversify their portfolio of activities for spreading perceived risk and smoothing consumption and income (Warren, *op. cit.*).

The less than perfect correspondence between asset costs and their derived rates of return enables income gains to be derived from diversification through the overall reduction of asset cost, although these gains decline gradually as the number of assets proliferates. In contrast, the *economies of scale* that reduce average cost as production increases diverge from income gains, since they favour specialisation (Robinson & Barry, 1987). Nevertheless, households in different agro-ecological zones would have different motives to diversify when the risk in cropping and the correspondence between rates of returns to farming and non-farming sectors differ (Reardon *et al.*, 1992). Studies of on-farm diversity have sometimes indicated that risk-averse behaviour may not always be necessarily present in activities of rural households, since diversification of on-farm cropping systems through methods such as micro-cropping and field fragmentation are able to take advantage of complementarities between crops, soil-type variations, and microclimatic differences which ensure the spreading of cultivation risks with little loss in total income (Norman, 1974; Walker & Ryan, 1990; Blarel *et al.*, 1992).

Coping behaviour is the involuntary response of rural households to disasters or to unanticipated failures in their major sources of survival, and can as such be regarded as the ex-post management of household consumption through adaptation in the wake of a livelihood crisis or collapse in search for new livelihood sources. On the other hand, vulnerability is defined as a high degree exposure to risk, shocks, and strains for externally threatening livelihood security and proneness to food insecurity because of lack of assets or social support systems (Chambers, 1989; Davies, 1996). Thus, the most vulnerable livelihood exhibits low resilience and high degree of sensitivity. Livelihood adaptation is thus defined as the process of continuous change in livelihoods that either increases livelihood security and wealth or reduces vulnerability and poverty (Davies & Hossain, 1997). But adaptation may result in adoption of successive more vulnerable livelihood systems over subsequent time (Davies, *op. cit.*), and it may go against the spirit of livelihood diversification.

In the literature fragmented labour markets in rural part of developing nations also create an urge for diversified livelihood. The rural labour markets of such nations are fragmented and thereby imperfect and incomplete, and in some cases underdeveloped, even non-existent. Work-seasonality along with risk indicate the role that labour markets play in reducing threats posed by unstable, uneven, and insecure income sources through diversity of livelihoods out of farm into off-farm or non-farm activities to construct a viable rural livelihood following social rule of accesses and guided by economic motives. Nevertheless, some studies (Binswanger, 1983; Reardon, 1997) on income diversification focus on diversification in relation to failures of rural credit markets in developing countries and thereby these are illustrative of diversification within crisis-situations. Given credit constraints, the use of off-farm income for purchasing recurrent farm-based inputs or farm equipment has been observed in developing countries (Evans & Nagu, 1991; Meindertsma, 1997). However, while harvest shortfalls and periodic reversals in the agricultural terms of trade are found to drive diversification, land constraints that prevail in the longer term do not. Again, while income diversification permits rural incomes and food consumption to be raised over subsequent years, cash-cropping does not appear to substitute non-farm activity but may be a strong complement to it, given the credit-constraints that apply to non-farm activity (Reardon *et al.*, 1992, *op. cit.*).

Rural households are observed to diversify their livelihoods in the long-term perspective of livelihood security rather than taking mere advantage of current income earning opportunities. For this purpose they make investment on assets, consisting of household factor endowments and surrounding social infrastructure, as asset strategy to enhance future income earning capability and livelihood prosperity, and this is viewed as an additional motive for livelihood diversification in the recent literature. A key gradient of the asset strategies is that they constitute a platform upon which livelihood strategies are

built up as well as provide a means of managing work-seasonality, minimising risk, coping with crises, and interacting with imperfect labour and credit markets (Ellis, 2000a). Thus, households having different asset endowments and asset strategies are able to manifest different degree of choice and necessity in deploying resources to diversify their livelihood as asset endowments are capable to reflect the impacts of other impulses for livelihood diversity by channeling resources through a particular asset strategy for livelihood diversity (Perz, 2005). However, the literature on household asset endowments and its effect on livelihood diversity are ambiguous. One view is that asset impoverishment leads to greater livelihood diversity, since asset-poor households have no alternative choice but diversification for enlarging their income as compared to asset-affluent household and thereby for lessening poverty and income inequality (Haggblade *et al*., 1989). But, the asset-affluent households are in suitable position to diversify their livelihood and thereby to raise their income than the asset-poor households (Reardon *et al.*, 2000). Thus for acquiring new income streams thorough introducing different enterprises, the diversity of household asset endowment is important since asset diversity enlarges degree of choice and allows flexibility in asset strategies (Bebbington, 1999; Zoomers, 2001).

Though the initial incentives for agricultural diversification comes from technological or demand driven factors or local niche or to cope with emerging threat and challenges, but for maintaining its sustenance and accelerating its momentum, infrastructural and institutional supports are needed. The economic return, change in fiscal policy, trade, and market forces determine the sustainability of cropping systems for a longer period and mainly responsible for crops fluctuations over years. Because of occurrence of any of the incidences of disease or insect pest in epidemic form in a component crop or change in labour availability or pricing structure of inputs / products or creation of demand for particular commercial crops or technological break-through, better alternative crops and new systems emerge to farmers for adoption at macro level (Velayutham & Palaniappan, 2003). Guiding by the motive of maximisation of expected future net return subject to technological, institutional, resource, and structural constraints, crop diversification has taken place in Indian states (Kumar & Mittal, 2003). Although market forces like prices of farm products, particularly in the context of increasing liberalisation and globalisation, play significant role in the choice of crops by the farmers and thereby crop diversification, but change in consumption pattern induced by dietary diversification is often viewed as an important factor for the deceleration in area under coarse cereals. Thus, now it is widely recognised that the shift in cropping pattern in the areas more suited to coarse grains needs to be reversed to ensure a more balanced nutritional intake (Nampoothiry, 2003). Diversification can thus take place within the parameters of national and global demand as price signals determine supply response in a significant section of the agrarian economy which is grounded within the regime of agroclimatic possibilities (Alagh & Alagh, 2003).

Selected studies have also investigated the individual roles of various determinants of agricultural diversification through regression analysis (Gupta & Tewari, 1985; Mani & Varadarajan, 1984; Joshi *et al*., 2004). At the micro level, diversification is inversely related to factors such as the size of farms and distance from markets, but directly related to family size and dairy-based incomes (Singh *et al.*, 1985), while in contrast another study (Chand & Singh, 1985**)** indicates direct relationship between agricultural diversification and land holding-size, and extent of agricultural diversification and altitude. However, though holding-sizes have an inverse impact on diversification, the success and speed at which diversification is accomplished depends on rural infrastructure (Chand & Chauhan, 2002). But the development of infrastructures such as roads and irrigation, and literacy among the rural people may result in crop concentration rather than diversification (Kar *et a*l., 2003). Nonetheless, when credit needs among farmers increase in the process of diversification, supply of institutional credit creates favourable influence on agricultural diversification (Datta & Basak, 1984; Saini & Singh, 1985; Chand & Chauhan, 2002). Agricultural diversification is also related to mode of farming, and is more prominent in capitalist farms than in the peasant farms (Pal & Pal, 1984).

2.2.5 Implications of Diversification

Diversification can be designed in a manner that assists poverty alleviation, employment planning, and environment conservation (Hayami & Otsuka, 1995), and planned diversification improve both individual and social gains (Haque, 1996). Thus in India, agricultural diversification has been adopted since the Eighth Five-Year Plan as a strategy for rural income augmentation and employment generation (GOI, 1992), and is also recommended as a means for the improvement of well-being among small and marginal farmers and even among landless labour (Azad *et al*., 1984; Saleth, 1997). Agricultural diversification as a part of rural diversification increases economic access to food in the broader sense through employment generation to the rural poor in India and thereby Indian economic development is agricultural growth centric (Mujumdar, 2006). Thus, diversification of agricultural production on small farms is a plausible means for increasing income and employment among the peasantry (Satesh *et al*., 1984). Diversification is also found to be associated with higher income as well as larger stable food consumption to rural poor as the strategy enhances the capability of rural households to maintain food security in face of recurring crises in agricultural subsistence (Reardon *et al.*, 1992 *op. cit.*). Thus, income diversification improves the survival capability of the poor in search for livelihood security under condition of distress (Matlon, 1979), and thereby more income diversification implies less income instability and less consumption variation (Walker & Ryan, 1990; Reardon *et al*., 1992, *op. cit.*). However, an opposite view also prevails where diversification has a negative impact on rural incomes distribution and thereby, diversification exacerbates rural differentiation, since several studies observe that richer rural households derive a higher proportion of their income from non-farm sources than poor households (Collier & Lal, 1986; Evans & Nagu, 1991; Webb *et al.*, 1992; Reardon *et al.*, 1992 *op. cit.*). But the role of diversification as a household strategy in unraveling the severity of poverty at the bottom phrase of income distribution does not imply that it has an equalising effect on overall rural income (Ellis, 2000a). The literature is also not consensus on the effect of livelihood diversification on household welfare since the observation that more diversified households are in better position in terms of livelihood security and standards of living (Reardon *et al*., 1992; Ellis, 1998) contrasts with another finding where households with greater livelihood diversity do not exhibit better welfare (Perz, 2005). In fact, attainment of improved standard of living is a cumulative process for which ability to build assets and diversify accordingly into farm and non-farm activities are essential, and thereby household asset endowments jointly determines its diversity and welfare (*ibid*).

Since the poverty driven people are more adversely affected by surrounding environment degradation than the rich (Dasgupta, 1993, 1995, 1996; Sharma, 2003), it is imperative to conserve its quality for maintaining the livelihood security of them under conditions of shocks and crises. Although agricultural diversification through horticulture bears genuine favourable impact on the sustainability of livelihood and surrounding environment (Bokil, 2002), the overall effect of livelihood diversification on environment in the literature is indecisive, conflicting, and complex because the sustainability of rural livelihood is not synonymous to the sustainability of a particular eco-system, despite having their major overlapping area. One view is that diversification into non-farm activities, especially if it is accessible in remote rural areas, lessens the need for asset-poor rural dwellers to carry out extractive practices in surrounding environment for their survival in the presence of economically better options than extraction of natural resources through gathering and collection (Lipton, 1991) and generation of resources that are then be invested in improving the quality of the natural resource base (Ellis, 2000a). Thus diversification has positive impact on surrounding environment. While the other finding reveals that diversification into non-farm activities siphoning off rural household labour force from farm into non-farming opportunities creates labour shortage and the resultant abundant of labour intensive conservation practices in farming, and the consequent unsustainability of local environment (Netting, *et al.*, 1989).

Agricultural diversification also improves the prospects of gainfully absorbing the large proportion of rural women who remain unemployed or underemployed in India (Rao, 1984). Agricultural

diversification through non-timber forest products provides a great promise for women in terms of opportunities for their greater involvement in poverty reduction programmes, since such products can accommodate the constraints of domestic duties of women and recognise gender difference in knowledge of natural resource, biodiversity, and conservation (Hossain, 2008).

2.3. Empirical Contexts and Impacts of Diversification

2.3.1 Physical/Agroclimating Zoning

Being a vast and humanly complex country, it is difficult to grasp the agricultural landscapes of India in their entirety without need for regionalisation. The primary regional divisions of India are commonly made on the basis of topography, with five principal natural regions commonly being distinguished, comprising (a) the Himalaya and associated Hills; (b) the Northern Plain which includes the Indian portions of the Indo-Gangetic Plain; (c) the Peninsular Plateau and Hills; (d) the East Coastal Plain; and (e) the West Coastal Plain (Khullar, 2000). The Indian Himalaya is further subdivided into two sub-regions, namely the Eastern and Western Himalaya. Subdivisions within the Northern Plain are made primarily on the basis of differences in precipitation, since rainfall intensity is the single most distinguishing variable within the plain. The West Coastal Plain is similarly subdivided into a perhumid Southern sub-region and a drier Northern sub-region.

Spatial patterning of the climatic phenomenon is very well marked for the country and is reflected in regional variation. In1918, based on monthly value of temperature and precipitation, Koppen divided the country into three broad climatic zones- arid, semi-arid and humid (Singh, 1995). Based on considerations of topography, soils and precipitation, the Planning Commission has defined 15 distinct agroclimatic regions within the country listed below (Alagh, 1990). Of them, 2 are located in the Indian Himalaya, 5 in the Northern Plain, 4 in the Peninsular Plateau and Hills, 1 in the East Coastal Plain, and 2 in the West Coastal Plain, all of which lie on the Indian mainland. The 15th region, namely the Islands Region, cover the Andaman & Nicobar island-groups in the Bay of Bengal and the Laccadive, Minicoy and Amindivi island-groups in the Arabian Sea.

THE AGROCLIMATIC REGIONS OF INDIA

I. WESTERN HIMALAYAN REGION
II. EASTERN HIMALAYAN REGION
III. LOWER GANGETIC PLAINS REGION
IV. MIDDLE GANGETIC PLAINS REGION
V. UPPER GANGETIC PLAINS REGION
VI. TRANS GANGETIC PLAINS REGION
VII. EASTERN PLATEAU AND HILLS REGION
VIII. CENTRAL PLATEAU AND HILL REGION
IX. WESTERN PLATEAU AND HILL REGIONS
X. SOUTHERN PLATEAU AND HILLS REGION
XI. EAST COAST PLAINS AND HILLS REGIONS
XII. WEST COAST AND GHATS REGIONS
XIII. GUJARAT PLAINS AND HILLS REGIONS
XIV. WESTERN DRY REGION
XV. ISLANDS REGION

However, according to Trewartha's climatic zonalisation, India comprises seven major agroclimates, namely a) Tropical Rain Forest, b) Tropical Savannah, c) Tropical Semi-arid Steppe, d) Tropical and Subtropical Steppe, e) Tropical Desert, f) Humid sub-tropical with dry winter and g) Mountain Climate (Sharma & Coutinho, 1983). On the other hand, based on physiography, soils, agro-climate and length of crop growing period, National Bureau of Soil Survey and Land Use Planning [NBSS&LUP], Nagpur, has divided the country into six eco-systems that cover 20 agro-ecological regions [AERS], namely a) Western Himalayan, b) Western Plain, and c) Decan plateau having hot arid climate under *Arid Eco-*

System; d) Northern plain and central high lands, e) Malwa high land & Gujarat plains, f) Decan plateau having semi-arid climate, g) Talengana plateau and Eastern ghats, and h) Eastern ghats, Tamil Nadu uplands and Karnataka plateau under *Semi-arid Ecosystem*; i) Northern plains, j) Central highlands (Malwa, Bundelkhand and Satpura), k) Eastern plateau, l) Chotanagpur plateau and Eastern ghats, m) Eastern plain, and n) Western Himalays with warm sub-humid climate under *Sub-Humid Eco-System*; o) Bengal and Assam plains, p) Eastern Himalayas, and q) North-eastern hills (Purvanchal) under *Humid-per Humid Ecosystem*; r) Eastern coastal plains and s) Western ghats and coastal plain under *Coastal Ecosystem*; and t) Islands of Andaman & Nicobar and Lakshadweep under *Island Eco-system* (Gangwar, 2003).

The west Coastal Plain, the Sahyadri, and some parts of Assam are under Tropical Rain Forest climate, with vegetation characteristics of dense forests and plantations of tea, coffee, and spices. Most of the peninsula, except the semi-arid zone in the lee side of the Sahyadris, experiences Tropical Savannah climate the natural vegetation of Savannah as well as a variety of crops with or without irrigation. The rain-belt stretching southward from central Maharashtra to Tamil Nadu in the leeside of Sahyadris and Cardamom Hills experiences Tropical Semi-arid Steppe climate with characteristics of dry farming and livestock rearing Tropical and Subtropical Stepp climate occurs over a broad crescent from Punjab to Kutch between the Thar Desert to its west and the more humid climates of the Ganga Plain and the Peninsula to the east and south respectively with dry farming and livestock rearing. The western parts of Barmer, Jaisalmer and Bikaner districts of Rajasthan and a large part of Kutch form the sandy wastes of Thar fall under Tropical Desert climate with characteristics of dry farming supplemented by sheep rearing. A large area to the south of Himalayas, east of the tropical and sub-tropical steppe and the north of the tropical savannah running in a long belt from Punjab to Assam with a south-westward extension into Rajasthan east of the Aravalli Range come under Humid sub-tropical climate with dry winter and variation of annual rainfall. The Himalayan and Karakoram ranges experiences Mountain climate with sharp contrasts between the temperatures of the sunny and shady slopes, high diurnal range of temperature, and high variability of rainfall in the range 66-321cm. in variation to altitude and slope aspect (Sharma & Coutinho, 1983).Climates in these regions range from hot desert or semi-arid to tropical monsoon, with considerable accompanying variations in their vegetational characteristics. These climatic and vegetational characteristics also influence the dominant agricultural and livelihood patterns of each region, with agricultural livelihoods in the less productive arid or ecologically-challenged zones being supplemented by animal husbandry activity. Particularly in the mountain tracts and in parts of the plateau and hill region fringing the coastal plains, agriculture and livestock-based activities are undertaken in proximity to forests ranging from northern temperate to dry deciduous type. Proximity to these forest tracts also provides fodder to domestic livestock, encouraging mixed farming by the residents of these regions. Of the two agroclimatic zones within the Indian Himalaya, the Eastern Himalaya has a wetter climate and consequently supports lush vegetation and dense forest.

2.3.2 Alternative Farming Systems

Farming system refers to a specific arrangement of farming enterprises which farmers manage according to their goals, preference, resource-base as well as cultural setting in response to biophysical and socioeconomic environment in the regions (Shaner *et al*., 1982). A farming system is the result of complex interactions among inter-dependent components, where farmers allocates certain quantities and qualities of their farm resources and management to which they have access (Mahapatra, 1994) so that it raises profitability without disclosing the ecological and socioeconomic balance. A farming system thus provides a vast canvass of livelihood gathering, a better risk coping strategy, a continuous flow of income and employment to the farm family (Behera & Sharma, 2007). Different farming systems have historically developed across the countries in ways that reflect the actions and choices of local people, influenced by local conditions with regard to regional politics (Koizumi, 2007).

Based on resource availability, dominant patterning of farm activities with intensity and household livelihoods including market relationship in the developing countries, their existing farming systems can be distinctly classified into eight broad categories, namely

(i) *irrigated farming systems*, involving a broad range of food and cash crop production,

(ii) *wetland rice-based farming systems*, dependent upon seasonal rains supplemented by irrigation,

(iii) *rainfed farming systems in the humid areas*, characterised by specific dominant crops and mixed crop-livestock systems,

(iv) *rainfed farming systems in steep and highland areas*, often characterised by mixed crop-livestock systems,

(v) *rainfed farming systems in dry or cold low potential areas*, with the characteristics of mixed crop-livestock and pastoral systems having very low productivity because extreme aridity or cold,

(vi) *dualistic farming systems* with the mixing of large commercial and small holders, across variety of ecologies and with diverse production patterns,

(vii) *costal artisanal fishing systems*, often incorporating mixed farming elements, and

(viii) *urban-based farming systems*, specifically focuses horticulture and livestock production (FAO, 2001b).

Based on the same criteria, India's farming systems can be classified into eleven broad categories, namely a) rice farming system, b) coastal artisanal fishing farming system, c) rice-wheat farming system, d) high land mixed crop-livestock farming system, e) *rainfed mixed farming system*, f) dry rainfed farming system, g) pastoral farming system, h) sparse (arid) farming system, i) sparse (mountain) farming system, j) tree crop farming system, and k) urban based farming system (*ibid.*). Gangwar (2003) broadly mentioned the Indian farming systems as tree/plantation-based farming systems in hilly areas, animal-based farming systems in dry or arid areas, and crop-based farming systems in irrigated and high rainfall areas. The farmers practice crop-livestock mixed farming systems in the Himalayan regions characterised by remoteness and limited social services, and the principal livelihoods in these regions are cereals, livestock, horticulture, seasonal migration trade, mountaineering and tourism. All such farming systems have currently faced multiple problems in the forms of stagnant crop-yields with low profitability, declining productivity, nutrient imbalance and degradation of natural resource-base, and hence their location specific further development is an urgent need (*ibid.*).

Since all the farming systems are dominated by small holder farmers (FAO, 2001b), for improving the living standard of farmers, especially the small farmers, small farm diversification and expansion of employment opportunities, particularly off-farm and non-farm rural activities, are urgent necessities. Higher income with maintaining environmental quality can be achieved in mixed farming system in which the ratio between arable production and animal determines the extent to which crop rotation can be widened and the relative amounts of slurry that can be applied to grassland (Boss & Van De Ven, 1999). Thus, for maintaining the sustenance of increased productivity without depleting natural resources or destabilising the environment, the appropriate strategy is integrating farming system which incorporates a range of resource-saving practices to achieve acceptable high profits (IFAD, 2010). Traditionally, Indian farmers adopt integrating farming system approach for livelihoods. Integrating farming system has revolutionised conventional farming of livestock, aquaculture, horticulture, agro-industry and allied activities (Chan, 2004), where proper integration of viable farm enterprises reduces farmer's inefficiency and thus increases agricultural productivity and income (Bradley, 2010; Ugwumba *et al*., 2010). This also can be a viable farming system for the small and medium farmers in water scanty regions (Channabasavanna *et al*., 2009). Diversified farming systems comprise components such as

crops and livestock that coexist independently from each other primarily to minimise risk, not to recycle resources, whereas in an integrating farming system, crops and livestock interact with each other to create a synergy with recycling allowance to use the available resources optimally (FAO, 2001c).

Since in India more than 65 per cent cultivated land are monsoon dependent drylands with low rainfall and poor soil fertility, input-intensive farming is not suitable for them, while such land can be effectively utilised by adopting various labour-intensive, integrating farming practices (Ganeche *et al*., 2000). However, the attempt of lessening the pressure on natural resources through partial conversion of rice-wheat cropping system into diversified cropping system in India reduces the profitability of such system (Singh & Sidhu, 2004). Thus, the rice-wheat cropping system does seem to need diversified through resource conservation technologies such as zero tillage to regain profitability and to generate less pressure on natural resources (Om *et al.*, 2008). In fact, conservation farming is gaining acceptance in many parts of the world as an alternative to both conventional and organic farming systems (Dumanski *et al*., 2006).

Agricultural researchers have also recognised the importance of sustainable agricultural production systems as well as modern civic society, and thereby they have placed increasing values on sustainable farming systems which have potential to improve wildlife and the landscape, and to lessen environmental hazards caused by farming systems. The organic farming systems perform better with respect to nitrogen loss, pesticide risk, herbaceous plant biodiversity, and most of the other environment indicators of sustainability than the conventional farming systems (Pacini *et al*., 2003). Moreover, the net income of the farmer may also be higher under organic farming systems than conventional farming systems (Bayramoglu & Gundogmus, 2008).

2.3.3 Combined Agricultural and Pastoral Farming

During agricultural diversification while there is a shift in the cropping-mix from food to non-food crops, progress is quicker in superior cereals such as wheat and rice than in inferior cereals. Moreover, such shift in cropping-mix is accompanied by other shifts within agricultural activity from crop enterprise to other enterprise and by shifts from the farm to non-farm sectors. Although superior cereals have thus gradually replaced coarse cereals among food-grains crops during the diversification process in India, the areal shares of oilseeds, fruits, and vegetables have increased over time (Satyasai & Viswanathan, 1996a). But diversification through high-value farm products such as fruits, vegetables, and horticulture is not equally suitable to all agro-climatic regions in India, and hence, the strategy of agricultural diversification needs to be location specific (Chand,1996a; 1996c). Indeed, diversification in favour of horticulture by substituting inferior cereals and livestock products is more pronounced in rainfed areas which are becoming a hub of non-cereals because of their low water requirement and abundant labour supply of the areas, though this phenomenon was by-passed during the 'green revolution' (Joshi *et al*., 2004). Moreover, agricultural diversification through incorporation of specific new crops such as mulberry-sericulture can also generate positive impact on farm income and expenditure in the agroclimatic regions which are agriculturally not progress (Gopalappa, 1996, 1997). While low levels of agricultural diversification in any region are reflected in poor growth of regional state domestic products [SDP] (Chand, 1999), diversified activities such as sericulture help in expanding export earnings and in transferring income from urban to rural areas, in addition to securing benefits for small and marginal farmers. Thus, the status of agricultural diversification produces differential growth performances in different regions, and the regions which were diversifying in favour of non-cereals farm products have witnessed better growth performance as compared to those specialising in cereals (Joshi *et al.*, *op. cit.*).

In India, where average holding-sizes have shown a negative trend for all major social groups, particularly among Scheduled Tribes, agricultural diversification is adopted as an alternative coping strategy in both agriculturally progressive and regressive regions (Singh, 2002). But in India the pace of

agricultural diversification is gradually gaining momentum for high-value farm products to increase farm income rather than to be a mere coping strategy to manage production and market induced risk and uncertainty (Joshi *et al*., *op. cit.*). While most empirical studies using farm-level data on the linkages between agriculture and livestock-related activity in India have been directed to the Punjab-Haryana region (Kahlon & Agarwal, 1967; Dhawan & Johl, 1969; Kahlon *et al*., 1975; Saini, 1975; George & Choksi, 1977; Patel, 1981), a few have focused alternatively on crop diversification between irrigated and rain-fed crops (Baliga & Tambad, 1964; Sarkar 1972), and on the impact of new farm enterprises like dairying and animal husbandry (Throve & Galgalikar, 1984; Mani & Varadarajan, 1984; Saini & Singh, 1985).

In agrarian economies characterised by the dominance of small and marginal landholdings and by high dependence on agriculture among the labourforce for livelihood, the production-base of farming activity is generally dominated by subsistence needs. Since crop diversification can create potential land-use conflicts between subsistence crops like food-grains and non-food crops, the process of diversification may transcend into the larger issue of rural food security embodying food entitlement in relation to food availability. These issues become important within the globalisation debate. It has been argued correspondingly especially in the context of dry-land agriculture that agricultural growth should no longer be limited by the goal of self-sufficiency, but can benefit from shifts to new activities with favourable domestic and export demands that encourage agricultural trade (Rao and Gulati, 1994). Krishanaswamy (1994) however questions such restructuring of agricultural production towards exports, arguing that current levels of agricultural output would yield limited margins for export if all people living below the poverty line were provided adequate means to satisfy their food needs. Thus substantial increase in agricultural output is seen to be a necessary precondition for growth in agricultural exports. Recognising that persistent food grain surpluses in global markets are a recent development that have aroused considerable interest from countries wishing to use these favourable trends to their economic advantage, Vyas (1994) nevertheless holds that such global changes do not warrant substantive change in India`s strategy towards achieving self-sufficiency in the production of staple food-grains. As a result, diversification is only favoured when the objective of self-sufficiency in cereals production has been effectively achieved. Agricultural diversification has also been discussed in the context of the New Economic Policy [NEP] in India (Prasad *et al.*, 1996; Satyasai and Viswanathan, 1996b; Nadkarni & Vedini, 1996). Under the recent WTO agreements directing the opening of agricultural markets, new opportunities have been created for agricultural exports. In relation to this, diversification towards innovative hi-tech agricultural enterprises involving floriculture, horticulture and agro- processing and expansion of the rural non-farm sector is observed to have gained momentum in agriculturally-advanced Indian states like Haryana (Ergano *et al.*, 2000).

In general, while declines in labour intensity have been observed in agriculturally progressive areas, labour intensity has been observed to increase elsewhere (Guha, 1990). The proportion of non-wage and non-agricultural income of rural households has however been seen to expand during poor agricultural years, when persons from outside the traditional rural labourforce including women enter the labour market and engage in various forms of self-employment or non-agricultural work (Unni, 1991). Nevertheless, prevailing customs and traditions still restrict the use the family female labour in farm activities (Acharya, 1992). Such factors that create imperfections within the labour market have a significant influence on the patterns of labour absorption in agriculture (Pandya, 1997).

Forest land by nature does not compete with crop land, rather it is complementary to agricultural production, and the women have no barrier to participate in allied activities like livestock activities. Thus, some specific studies (Ghayur, 1987; Singh, 1988; Rao, 1988; Chaudhury & Aneja, 1988; Singh *et al*., 1988; Suryanarayana, 1989; and Sharma & Chand, 1992) focus on agricultural diversification towards allied activities such as forestry and apiculture through integration with agriculture and livestock activities for raising resource-use efficiency, producing additional resources for food and

nutrition, and generating income and employment for the rural farm households. The participation of farming households in subsidiary activities such as dairy enterprise also creates more employment opportunities for family labour even during lean periods (Verma & Pant, 1978). An expansion of livestock activities not only absorbs unemployed and untrained rural labour at the door steps of the farm households, but it reduces urban migration (Mahmood, *et al*., 2009). The livestock also plays immense role in stabilising income through generating continuous income to farm households (Saini & Singh, 1985) as well as embodying savings and acting as an insurance in emergency against the risk involved in crop failure (Kurosaki, 1995). Moreover, livestock produces an additional benefit of credit to their owners beyond the sale, slaughter, or transfer value of their livestock, since they can dispose of their animals when they choose to do so (Roy & Fitaweke, 2011).

Crop-livestock integration is the only method for providing additional income and employment to the marginal and small farmers, even to the landless households (Sastry, *et al*., 1993; Nedunchezhian & Hirunavukkarasu, 2009). Besides generating increased income and employment at the production level, the livestock creates important backward and forward linkages in rural economy (Singh, 1994). In India, livestock activity contributes around one-third of the total farm income, and marginal farmers derive greater benefits from livestock rearing both for milch and draught purposes (Singh & Tiwari, 1994). Livestock contribute over half of the value of global agricultural output and one third of the value of agricultural output in the developing nations (Bruinsma, 2003), and thereby play immense role in poverty relief. In addition to their usage as source of foods, livestock are also used for draught power and transport, and their manure is applied on cropland for enriching soil fertility (Sharma, 2004). Thus, livestock is generally considered a key capital asset for rural families, and it offers advantage over other agricultural activities for promoting gender balanced development in rural areas (IFAD, 2003). Although women's participation in livestock management is relatively high in activities such as treatment of animals, decision regarding size of herd, purchase of animals, and sale of animal's produce, it is comparatively low in animal sale (Arshad, *et al*., 2010).

Livestock production systems vary extensively across the globe in variation to their use of land as well as livestock species. In order of intensity, the global livestock production systems can be broadly categorised into a) 'grassland-based' pastoralism and ranching, with the characterisation of least intensity and entirely dependent upon ruminant livestock, b) 'mixed-farming', either rainfed or irrigated, and c) 'landless', mainly pig and poultry production systems (Sere & Steinfeld, 1996). Inter-regional differences in livestock production systems also depend on agro-ecological features, human population density, and cultural norms (Upton, 2004). Nevertheless, in mixed and integrated farming systems, livestock contribute to both agricultural intensification and diversification, and farming systems diversification is usually initiated by a new productive activity such as a dairy unit on holding previously used only for crops to lessen the overall inter-year variation in household income, despite the yields of crops and livestock are not positively correlated (*ibid.*).

The livestock is an integral component of agricultural production system in India and it contributes variously to its socioeconomic development, particularly when societies evolve from subsistence agriculture into cash-based economies. The main economic contributions of livestock farming to India's economic development are- a) contribution to national income, b) provision of inputs to agriculture, c) generation of employment and eradication of poverty, d) provision of food and nutrition, and e) contribution to trade (Birthal and Rao, 2002). However, either as independent or subsidiary occupations, animal husbandry, poultry, and fishing do not have uniform bearing on the regional incidence of rural poverty in the country (Haque, 1984). Although agricultural diversification implies a tendency of shifting within rural occupations from crop cultivation to livestock and dairy activity, the contribution of crop cultivation to rural employment in India continues to remain immense. Moreover, despite recent rural occupational shifts from primary crop production, forestry and logging to subsidiary activities such

as animal husbandry, poultry, and fishing, India's rural economy will remain largely crop-based for many years to come.

2.3.4 Seasonality

As a push factor seasonality plays critical role for diversification in natural resource-based livelihoods, especially in areas of a single annual harvest (Ellis, 2004). Rural economic environment is inherently bound with seasonality. Seasonality implies cyclical levels of activity applicable as much for rural landless families dependent upon agricultural labour market for survival, as for farm families (Ellis, 2000b *op. cit.*). The livelihoods of rural non-farm families dealing in trade on farm products and inputs are also influenced by seasonality. In economic terms, seasonality implies that the returns to labour time in on-farm and off-farm labour markets vary during the year (*ibid.*). Seasonality causes peaks and troughs in labour utilisation on the farm, and creates food insecurity because of mismatching between constant consumption needs and an uneven flow of income (Ellis, 1999). Thus, for reducing seasonal income variability and for smoothing consumption, especially when other methods such as savings, credit and insurance are unavailable, households need to allocate their resources in multiple activities (Ellis, 2000a). Seasonality causes a change in occupation as labour time is switched from lower to higher return activities (Alderman & Sahn, 1989). The sequential and seasonal nature of agriculture implies that rainfall amount and its timing is an important determinant of crop-yields and income.

The dominant crop and non-crop income sources in different farming systems vary widely across seasons. During the wet season, rice will continue to be the dominant source of income in all South Asian regions but upland environments which have comparative advantage in non-rice crop production as well as in a range of complementary livestock activities (Dorjee *et al*, 2003). The dry season rice will continue to be the major income source for the rice and rice-wheat systems in irrigated lowland, while for the rainfed lowlands in dry season the dominant activity will essentially be non-crop activities, off-farm employment and livestock production as well as cottage industries (*ibid.*). Hence, the labour and capital investment in dominant crop cultivation differs substantially across seasons in different agroclimatic zones, and thereby this indicates existence of seasonal unemployment in all the farming systems. The diversified farm however, generates an extended work for farmers and farm workers during the off-seasons in any region, providing social benefits in terms of year-round stable employment (Johnston, *et al.*, 1995). Although the irrigation infrastructure is geared towards rice production in irrigated lowland, the farmer has several options available to grow non-rice crops such as vegetables during the dry season (Pingali *et al.*, 1989). The most feasible way of raising rural income through diversification is to reduce the extent of land commitment to rice cultivation in dry season (Mariyano, 2007). The flexibility of farmers in switching from rice to non-rice crops and vice versa is low, during the rainy season, for the tropical lowlands and the rice-wheat zone, because of high drainage costs for growing non-rice crops (Pingali *et al.*, 1997), while upland areas can oscillate between rice and non-rice crops with minimum additional investments (Pingali, 2004). However, the extent of comparative advantage for dry season diversification depends on the physical constraints and the market opportunities for non-rice crop production in the irrigated lowlands (Dorjee *et al*, *op. cit.*).

On the dry season rural farm households in Africa diversify their livelihoods into non-farm activities because of fulfilling their cash needs for purchasing foods after consuming own production and for buying non-farm goods and services as well as for safeguarding their own farming (Reardon, 1997; Ellis, 1998 *op. cit.*). Such diversification into local non-farm enterprises mainly improves ability to survive against recurrent seasonal hunger (Cekan, 1992) as well as acts as a source of self-insurance against indebtedness and borrowing (Davies, 1996). A study (Oseni, 2007) in rural Nigeria reveals that rural households with nonfarm earnings roughly double their purchases of cash inputs in agriculture than households without nonfarm earnings. Even during the crop growing season smallholder households allocate labour into non-farm activities mainly because of higher labour return in non-farm

activities, presence of surplus labour owing to land-constraint as well as more evenly year-around spread of non-farm activity in areas with more than one rainy season (Reardon, *op. cit.*). The evidence from Zambia finds that despite the agricultural work load in growing season, the poorest households with insufficient food stocks and limited cash are compelled to allocate their labour time in non-farm income-earning opportunities outside of their own farms (Kumar, 1988). Such non-farm diversification is described as permanent adaptive strategy for poor households (Assan, 2014), although self-employed non-farm enterprises households may close their enterprises temporarily when household members are required to work in agriculture (Nagler & Naude, 2014).

For lessening income instability, income-earning opportunities outside the farm should not be matched with the farm's own seasons. Ellis (1998) suggested that seasonal migration to other agricultural zones was one viable option and circular or permanent migration by some family members to non-farm occupations was another. Under circumstances of barely sufficient survival from own-farm output, livelihood diversification in the form of seasonal migration is not accompanied by a change in income sources of the resident group; rather the size of the group changes to accommodate its seasonal inability to feed itself (Toulmin, 1992; Ellis, 2000b).

2.4. Diversification in Mountain Regions

2.4.1 Mountain Environment and Ecology

Mountain regions represent the complex and interrelated ecology along with major ecosystem of the planet. Environmental conditions in the mountain areas, where natural hazards occur with greater frequency than in the plains, are relatively fragile. Thus, they are extremely vulnerable to human activities and natural processes (Liu, *et al*., 2002). Several mountain regions across the Himalaya and elsewhere have already reached or surpassed their inherent limits of carrying capacity because of high rates of growth of population combined with unsustainable regulation and use of natural resources. Along with accelerated natural hazards, the regions have experienced rapid loss in habitat and genetic diversity (Norbert *et al*., 2000). Partly because of the paucity of research, understanding about the planning and management of natural, human and bovine resource-use in the Himalayan region is generally poor (Shah, 1982). Thus to mitigate such hazards, mountain people developed indigenous ways of managing lands and resources that involve both individual as well as collective effort. However, frequent changes in policy place the development of mountain agriculture at risk, resulting in the proliferation of activities that achieve short-term gains but simultaneously push mountain farming systems towards unsustainability (Yanhua *et al.*, 1992).

Several negative changes in mountain environments that have occurred at all mountain farming sites have steadily deteriorated the conditions of mountain habitats and its people. Forests and pasturelands in many areas have either disappeared or have been degraded beyond their regenerative capacity (Gallcla and Garcia-Romero, 2007), also reducing the availability of organic composts and manure for crop cultivation and thereby, weakening the erstwhile forestry-farming linkages. Land degradation in terms of soil and nutrient losses is a quiet crisis that is unfolding gradually in the hilly and mountain areas (Sherchan & Gurung, 1992; Partap and Watson 1994; Partap and Shah, 1996; Tripathi, 1997; Gardner *et al*., 2000; Acharya *et al.*, 2001; Ebrahim, 2001; Thapa, 2002). These circumstances have led to secular declines of crop-yields that also imply that mountain agriculture is becoming increasingly unsustainable (Shrestha and Katwal, 1992) as well as to an increase in the cost of farm production (Tripathi *et al*., 2001). Moreover, because of increasing poverty and social pressure, mountain ecosystems will further deteriorate, and this may have an important impact on global environment (Peterman and Peters, 1998).
The indicators of unsustainability of mountain agriculture, whether visible or invisible, are related to resource-base, production yield, and changing resource use and management practices of mountain farming community (Kumar & Hotchkiss; 1988; Jodha *et al*.,, 1992; Shrestha, 1992; Dev, 1994), and are manifested in dwindling cultivable land-man ratio as consequence of population growth, scarcity of

farmland resources, decline or stagnant yields of farm land, and lack of diversification and resource regenerative farming practices (Partap & Shah, 1996). The degradation of natural resource base, *inter alia*, has led to increasing frequency and intensity of landslides, gully formation, erosion, and lessening fertility of top land-soil. Consequently, such adverse incidences have led to abandonment of farming land, fragmentation of land holding, scarcity of land resource, and decline in water flow for irrigation, and thereby making the mountain environment more unsustainable (Sharma, 1996). Moreover, competition for limited resources can be enhanced by private and state interference leading to the loss or overexploitation of community assets (Kreutzmann, 2002). Thus, along with deprivation of property rights, the contiguous people, especially belonging to least privileged and marginal groups, of mountain regions lose their grip on previous entitlements (Saberwal, 1999).

Crop yields and outputs in mountain regions are intrinsically limited by altitudinal variations and agroclimatic, and pedological constraints. With the growth of rural population, agricultural productivity declines further as a consequence of extending cultivation to marginal and steep sloppy lands that are inherently less fertile and also less suited to agriculture. The mountain farmers replace deep-rooted crops by shallow-rooted crops for quick return and add substantial number of inferior quality cattle to their existing livestock to rescue from emerging liquidity crisis. Along with multiplication of environmental hazards, soil conservation technologies, requiring substantial establishment costs, high usage of labour, and other inputs, become cost-ineffective as population densities increase (Singh, 2001). The hill farmers also deny to adopt recommended land augmenting and land conserving technologies because of their risk averse and conservative attitude (Bifani, 1992) as well as low returns and inadequate on-farm demonstration about possible benefits and risks of such technologies (Ya, 2001). Natural resources are also threatened by depletion and contamination in rapid and acute resource degradation. Prevailing patterns of ownership and utilisation of land in mountain regions also contribute to the instability of mountain farming systems. Where shifting cultivation still survives under tribal modes of land ownership, the shortening of *jhum* cycles affects forest regeneration, decreasing the sustainability of the system (Shelley, 2000; Singh *et al*., 2002). The threatening unsustainability in mountain farming can be partly explained in terms of the mismatching policy execution of the development planners in the quest for enriching living standard of hill farmers and partly in terms of growing population pressure on land and insatiable needs of external dwellers on its local resources (Reppetto & Holmes, 1983; Jodha, 1991; Sankrityayana, 1996). Nevertheless, the impact of such environmental changes extends far beyond agriculture, as the resulting losses in food production and environmental quality also restrict the quality of life (Yadav & Rai, 2001).

With natural resource-base degradation and declining crop-yields in the mountain regions, large scale adoption of water and soil conservation strategy having least hazardous effect on mountain environment is highly deserved for intensive agricultural practices, especially horticulture (Dhyani *et al*., 1993*).* While all farming activities in mountain areas suffer under cost escalation, soil conservation activities are more vulnerable to cost spirals since they yield precarious net returns despite their higher establishment and labour costs (Nadkarni, 1988; Acharya, 1992). Since the dependence of mountain farming on forests for fodder and fuel-wood is inversely related to farm-size, households at the lower echelon of society are affected more adversely by deforestation than their wealthier counterparts (Sharma *et al*., 1989). The double production-squeeze from decline in terms of trade and chronic overproduction of traditional crops on a limited land-base is deeply characteristic of the socially and sectorally segregated peasant economies present in mountain regions, and forces agricultural households to expend ever-increasing amounts of labour in order to survive (Zimmer, 1992). The mountain farmers also face difficulty in terms of high transportation cost to sell farm-produce because of their inaccessibility, remoteness and difficult hill terrain, along with limited access to market and road connectivity (Thakur *et al.*, 1997).

Mountain farmers have responded to such challenges by either adapting to or modifying mountain characteristics through appropriate institutions and methods. However, public interventions which have contributed in some degree to improvement in crop-yield, appear to have disregarded mountain specificities and thus are seldom sustainable (Shrestha & Katwal, 1992), and make the mountain tracts more degraded and keep the people under poverty. The poverty of mountain communities and its persistence despite the rich natural resources of mountain regions are both a cause and consequence of unequal highland-lowland economic linkage (Jodha, *et al*., 2002). Nevertheless, increasing scarcity of water for mountain households, especially in dry season, has led to increased out-migration of farm households from mountain slopes with low population density to valleys with high population density, and thereby resource available in the mountain slopes are left idle (Khanal, 2001). But, out-migration of male workforce has still viewed as one of the important strategies of mountain people to cope with the problems caused by the lack of productive employment opportunities in their home areas (Bhadra & Khanal, 2002; Olimova & Olimova, 2007) and results in an increasing burden on women (Banskota, 2000).

Given these constraints, development in mountain regions is conceivably achievable through sustainable increases of agricultural productivity that preserve the farming-forestry-livestock linkages of mountain farming systems while following an integrated approach to land management that protects mountain environments. The twin objectives of increasing agricultural productivity and protecting the environment through resource-regenerative recycling systems may nevertheless appear to be in conflict when farming-forestry-livestock linkages have to be maintained (Yadav, 1992). Topographical diversity and steep slope gradients in different mountain regions make cultivable land a scarce natural resource in the Himalaya. An integrated systems-approach to land management that optimises the utilisation of natural resources is thus mooted as a solution (Sankrityayana, 1997).

2.4.2 Horticulture, Floriculture and Allied Activities

Traditional agriculture cannot meet the food requirement of most mountain people. Production of adequate amount of food crops on small landholdings, with ever declining productivity, is impossible (Panday, 1992). Recently, with rapid and intensive economic growth, population dynamics and climate change, the traditional adaptation mechanisms of the mountain famers are losing efficacy (Choudhary *et al*., 2011). However, the changes in global market and society open new options for high-value product diversification based on harnessing local climatic niches to them through developing proper value-chain system and utilising their traditional knowledge to tackle poverty *(ibid.*). The higher commercial extraction of such products, especially non-timber forest, medicinal and aromatic, may lead to loss in bio-diversity and unsustainability in forest land and farming systems. Alternatively, for poverty relief, they may diversify their farming systems in terms of horticulture, floriculture and allied activities without penetrating into surrounding forests.

Sustainable mountain farming is feasible in areas that are still endowed with adequate forest resources where there have been few interventions from market forces and low transformation within traditional agriculture (Yadav, 1992). Economic development in such areas is thus possible through conservation of native crops and agricultural diversification, enlargement of more livelihood options with qualitative improvement, and thereby livelihood diversification. While *in situ* conservation of mountain crop systems is a key component of sustainable mountain development strategies, the success of such strategies depends upon the ability of peasant household to devote land, labour, and capital towards this (Camino, 1992). Mountain farmers manage land resources by diversifying their activities while maintaining close linkages between various spheres of farm production (Yanhua *et al.*, 1992). The sustainability in land use depends on local farmer's acceptability (Tiwari, 2000), which is again determined by their needs and comprehensiveness of risk and returns related to such practice (Purushothaman, 2005). Livelihood systems based on tradition practice with agriculture and livestock is found to be most congenial to mountain ecology (Sarkar, 1998). Existing mixed farming systems assist

the farmers to efficiently utilise own labour for long periods and farm byproducts, to stabilise annual net returns and to reduce business risk, and thereby they pave the way for sustainable agriculture (Kumar *et al.*, 2003). Their crop-choices also depend upon the existence of suitable agroclimatic conditions for particular crops. In areas where the chosen crop can be cultivated at relatively lower risk and less labour, a monoculture farming system may result. On the other hand, in areas where agroclimatic conditions are extreme and crop-production alone cannot provide rural households with adequate income, the diversification of rural enterprise and activities becomes more important (Bhati *et al*., 1992).

On-farm diversification towards cash-crops, especially fruit, helps the mountain farmers to use their scatter and relatively sloping marginal land profitably and productively (Sharma, 2005). Such land-use also maintains land quality, since it conserves and protects top-soil and thereby lessens soil erosion. More commitment of land to vegetable, fruit and floriculture makes the small landholdings viable and improves the living standards of the small landholder (Vaidya & Sikka, 1992). Since horticulture are labour-intensive and generate high and quick return, agricultural diversification through horticulture provides farmers an opportunity to utilise their surplus labour and augment their farm income (Birthal *et al.*, 2007). Agricultural diversification through subsidiary activities such as bee-keeping and through highly labour-intensive niche products such as exotic flowers and medicinal plants also appears to be a viable strategy for improving land productivity and reducing land pressure in mountain areas. Agricultural diversification through floriculture has great economic potential in sustaining the livelihoods of mountain people, since income from per unit growing area under floriculture is relatively higher than under other horticulture (Swarup, 1993). Diversification of agricultural, horticultural and livestock enterprise opens several avenues for ancillary activities (Jodha *et al.*, 1992) and helps to transform the traditional subsistence farming into market oriented agriculture in the region (Badhani, 1998).

On the other hand, non-farm diversification through micro-enterprises, especially which harness local resource and niche products, can play a crucial role for raising income and enriching living standard of mountain people (Upadhyay & Misra, 2004). Diversification may also arise because of introduction of leasehold forestry system where a part of community forest is allocated among the poor, involving the poorest of the poor, i.e., women (Shrestha & Dev, 2004). Such diversification improves the livelihoods of the poor in terms of improved food security, and it also lessens income inequality and gender disparity through increasing opportunity cost of women labour, along with conserving natural resource and biodiversity (*ibid.*).

In Himalayan regions, agricultural diversification through vegetables also seems to hold a huge potential in employment and income generation, since the success and profitability of such diversification does not depend on farm-size but on the provision of infrastructure (Kumar *et al.*, 2002). However, the production and marketing of such horticultural crops involve greater risk than the traditional crops. Hence, famers who design cropping strategy based on vegetables needs to diversify their cropping patterns for reducing risk (*ibid.*). In mountain regions, marketing of high value cash crops is mostly controlled by middlemen or commission agents who take major part of the consumer price. Thus, for stabilising and raising agricultural production and income through horticultural development, marketing must become an important and essential component in the region (Banskota, 1993). Because of highland-lowland linkages and proximity or distance from markets, the choice of diversification strategy by the hill farmers must be location-specific (Chand, 1996a). Nevertheless, cultivation of cash-crop raises women participation in related off-farm employment opportunities, since such off-farm activities based on cash-crops are female-work oriented and these are confined in the locality (Yu & Chen, 1992; Partap, 1995).

In mountainous regions, although rural households indigenously diversify their livelihoods in terms of multiple options such as crops, livestock, horticulture, forestry, agro-based cottage industries and other off-farm activities, many of such options usually do not generate high income, and hence, they are compelled to adopt greater activities for subsistence (Sharma, 1996). However, the logic for involving diverse livelihood options of an affluent household is to internalising the externalities (*ibid*.). Even in a congenial environment, poor mountain people did not indulge in fruitful livelihood options because of their limited capability. Nevertheless, the success of different developmental efforts to mitigate poverty and loosen natural resource-base in the mountains regions does not depend primarily upon provision of money and good wishes, rather it is more critical on the existence of stakeholders, structures as well as the functioning regulatory mechanisms and prevailing norms within the mountain society (World Development Report, 2002).

2.4.3 Livestock Farming in Mountain Areas

Livestock is an integral part of faming system in mountain regions where along with crop cultivation activities farmers rear a certain number of animals for multiple purposes such as milk, meat and fibre production as well as income generation to meet their other needs (ICIMOD, 1994). Limited cropping with low crop-yields and seasonality act as push factor, while congenial ecology and environment and relatively greater access to green fodder act as pull factor for rearing livestock in the regions. Livestock contribute to both intensification and diversification of income streams in mixed and integrated farming systems (Upton, 2004). Besides generating additional income and employment, livestock also assist the farmers to raise crop-productivity through maintaining soil fertility by providing manure in the regions where loss in soil nutrients is relatively higher because of sandy soil in cropland and eco-fragile environment. Because of slope gradients and narrow stretched of cropland and thereby inapplicability of mechanised method of ploughing in the mountains, livestock also play an imperative role in crop cultivation through provision of draught power. Livestock recycle nutrients on the farm, produce valuable output from land that is not suitable for sustained crop production and supply energy and capital for successful farm operation (Gurung *et al.,* 2005). Reasons for the prevalence of mixed farming systems in the regions are thus the possibility of spreading risk across crop and livestock production over time and space, deriving the complementary benefits from crop-livestock mix and creating flexibility that allows to adjust crop-livestock ratios for anticipating risks, opportunities and needs (Grunenfelder, 2005).

The livestock account for substantial proportion of agricultural GDP and relatively higher proportion of total GDP in the mountain regions, although these shares are gradually declining over subsequent periods (Sileshi and Tegene, 2000; Tashi & Partap, 2000). With relatively lower crop cultivation activities and seasonal variation in agriculture, seasonal migration of labour, especially the male, is a common phenomenon in all mountain sites. The livestock lessen the intensity of rural-urban migration and reduce the extent of disguised unemployment through creating off-farm employment opportunities all round the year, and also uplifts the living standard of the poor mountain people through provision of nourishing food-substances and financial returns (Luitel, 1997). However, the size of the livestock, particularly the bovine animals, is positively associated with land holding-size, and the distribution and composition of livestock in the mountain regions vary substantially in variation to their climate, availability of fodder and crop-residues and caste demography (*ibid.*). Consequently, all hill farmers have not realised equal opportunities from livestock farming.

Because of poverty and unavailability of LPG in the remote mountain areas, the farm households primarily depend on firewood as daily fuel energy, and thereby they damage trees to meet their firewood need which tends to degrade forest land. Livestock lessen the pressure on forest land by partly substituting firewood by cow dung, and thereby they help to check the environment degradation (Gurung, 1987), while they generate negative impact on forest in terms of loss of important tree sapling and forest flora. Nevertheless, income diversification through livestock and off-farm activities as well as

intensification of livestock activities though improved breed help many mountainous farm households to escape from poverty and thereby to conserve the unique natural and cultural resources (Krishna and Radeny, 2006; Kristjanson *et al.,* 2006; Kristjanson *et al*., 2007). For poor farm households, livestock, especially small ruminants, act as saving, buffering, and insurance as well as an easily available convertible asset that can be used in emergency (Gurung *et al.*, 2005). Rural diversification through livestock development programmes also reduces inequalities across different household groups and within the categories among mountain farmers (Sharma, 1992).

The economic performance of livestock and cattle, particularly milk-yield, in the mountain regions is poor partly because of predominance of indigenous cattle in total cattle population (Luitel, *op. cit.*) and partly owing to inadequacy and less qualitative fodder. The need for milk yielding, adaptability to local feed condition and diseases, and the provision manure and insurance as well as financing role of cattle jointly determine smallholders' breeding composition of livestock (Bebe *et al*., 2003). To cope with poverty, mountain farm households rear large number of animals which exceed the carrying capacity of land resources and thereby undermine sustainability and productivity of farm resources (Thapa & Paudel, 2000). Generally, carrying of a region is calculated based on estimated annual biomass production and feed needs by livestock (Grunenfelder, *op. cit.*). Thus, generation of additional fodder from the crops, farm fodder and cultivation of fodder trees on the sloping land through improved management of land resource is an urgent need to feed the excess livestock (Thapa & Paudel, *op. cit.*).
Livestock production systems are becoming quite dynamic through introducing the practice of smallholder commercial dairy farming with an increased number of improved breed animals in certain pockets areas in the mountains which have access to roads networks, markets for milk selling, and better veterinary health service (Tulachan, 2000b). Such exotic-bred cattle have less adverse impact on environment because of their larger dependency on market purchased feed, while they have greater contribution to improved livelihoods since they can generate higher milk (*ibid.*). Smallholder dairy farming is thus becoming a driving force behind rural transformation in the regions which are dominated by accessible mixed farming systems (Tulachan *et al.*, 2002). In the regions, small-scale dairy production is practiced as a part of subsistence farming under the sedentary system of animal management. However, small holder dairy farmers are facing multiple difficulties arising out of limited mobility, poor communications, and isolation as well as constraints like reduced forest and grazing land, changing floristic compositions and low yielding dairy breeds (Singh, 2000).

One of the critical issues of the sustainable mountain development is gender dimensional development, since gender inequality is viewed as a root cause for impoverishment and an expression of social injustice. Gender is a vital issue for the sustainable management of livestock because women play crucial role and bear higher work-burden with their relatively greater knowledge and skills than men in livestock production management (Karki & Tulachan, 2000). Dairy was originally developed as women enterprise (Chavangi & Hansen, 1983) in which women milked the cows initially and prepared milk-based products latter. Besides provision of household income, livestock also play a critical role in gender mainstreaming and addressing the concerns of disadvantaged socio-economic groups (Gurung *et al.*, 2005). Generally, rich farmers and higher caste people raise greater large ruminant such as buffaloes and cattle for milk purpose, while poor and disadvantaged ethnic people tend to raise higher small ruminant such as goats, pigs and poultry (*ibid.*). Small ruminants and poultry birds owing to less capital embodiment are less risky and they offer greater autonomy and decision making to women (Tulachan, 2000b). Although mountain women play significant role in the general management of livestock and are responsible for the maintenance livestock and home consumption and selling of micro livestock, even selling of milk and milk-based products, men maintain structural authority of livestock and are still in charge of any cash generated through livestock farming (Njiro, 2000). The decision making power and control over major livestock product business, trade, investment, and veterinary services of the women are limited because of their inadequate assets and information (Gurung *et al., op. cit.*). Nevertheless, women's involvement and role in livestock management and their control over livestock resources and

income as well as management decisions vary across ecological zones, caste, community, religious and cultural practices, income groups, and types of livestock animals which they reared (*ibid*.).

2.4.4 Impact of Climate Change on Mountain People's Livelihood

Both direct instrumental records and environmental proxy records point toward relatively higher historical and recent changes in climate in many mountain regions than in the adjacent plains of the world. Since mountain areas have a marked and complex topography, their climates vary considerably over short distances (Kohler and Maselli, 2012). Because of global warming, a large part of the Eastern Himalayas is experiencing warming of generally 0.01^0 to 0.04^0 C per year with the highest rates of warming in winter and the lowest, or even cooling, in summer; there is progressively greater warming with elevation, with areas above 400m undergoing the greatest warming rates up to 0.06^0C (Sharma *et al*, 2009). The warming in the greater Himalayas has been much higher than the global average: for instance, 0.06 ^{0}C per year in Nepal than the global average of 0.74^0 over the last 100 years (Du *et al.*, 2004; Eriksson *et al.*, 2009), and high altitude ecosystems are even more at threat (Shrestha *et al.*, 1999). Global warming reduces snow cover, melts away glaciers, and degrades permafrost (Lawrence & Slater, 2005; Bavay *et al.*, 2009). Himalayan glaciers are receding faster today than the world average (Dyurgerov & Meier, 2005) because of precipitation decrease in combination with temperature increase (Ren *et al*., 2003). Since up to 50% of the average annual flows in the rivers are contributed by snow and glacial melting in the greater Himalayas, their much higher warming is having a severe impact on downstream water availability in both short and long terms (Eriksson *et al.*, *op. cit.*). Interseasonal, interannual, and spatial variability in rainfall trends have been observed across Asia during the past few decades (*ibid.*). There is evidence of noticeable increase in the frequency and magnitude of extreme weather events such as high intense rainfalls with unpredictable monsoon onset, landslides, heat waves, tropical cyclones, prolonged dry spell, snow avalanches, thunder and dust storms in many mountain regions (Cruz *et al.*, 2007).

These climates changes have potentially serious consequences for mountain ecosystems and people, as well as for the downstream areas. Climate changes will definitely increase livelihood risk, since expected increases of heavy rainfall, heat waves, and glacier melt will amplify hazards in many mountains worldwide (Kohler and Maselli, *op. cit.*). Climate changes have been reported to impact on grassland productivity, ecosystems, and the distribution and composition of plant communities (Wilkes, 2008). Increasing temperatures and water stress are expected to produce 30 per cent decrease in crop-yields in Central and South Asia by the mid-21st Century (UNDP, 2006). In the context of Uttarakhand under Garhwal Himalaya, climate changes have resulted in adverse impacts on people's livelihoods in terms of overall declines in agricultural productivity, drying up of springs or less flow in springs and stream, as well as lack of fodder and increased incidences of pests and crop diseases along with double flowering of Malta orange and apple trees (Macchi, 2011). Thus, the rapid climate changes, combined with socioeconomic threats and perturbations, are adversely affecting the landscapes and communities in mountain regions (Sharma *et al*, 2009, *op. cit.*). Although mountain social-ecological systems have a great potential for adaptation with comparative advantages and a wealth of adaptation mechanisms historically developed by mountain communities for their survival, these mechanisms are losing their efficacy under present conditions (Choudhary *et al*., *op. cit.*). Recognising that climate changes have negative consequences on agricultural production, the hill farmers may diversify their crop-base to build more resilience, since crop diversification can improve resilience by engendering a greater ability to suppress pest outbreaks and dampen pathogen transmission, as well as by buffering crop production from the effects of greater climate variability and extreme events (Lin, 2011, *op. cit.*).

2.5 Agendas for Rural Livelihood Research

2.5.1 Existing Research Gaps

The literature reveals that diversification takes heterogeneous forms and the factors in diversification are specific to location. A debate also exists in the literature regarding the impact of diversification on rural poverty relief, its impact in raising farm productivity, and the determinants of agricultural diversification at micro level. Hence, more location-specific micro-level studies of agricultural diversification need to be conducted for clarifying these debated issues. Most existing case studies on agricultural diversification are partial as they concern a specific component within agriculture. Such studies do not therefore reveal the relative economic potential of different agricultural sub-sectors. Since the sustainability of farming systems depends upon proper integration between such sub-sectors components, a micro-level study of agricultural diversification in predefined farming systems is essential. While studies of this variant are still very few, the existing macro-level studies cannot clarify the importance of farmers' decisions in adopting a diversification strategy.

Several existing studies on the development problems of mountain regions point out that the growing unsustainability of mountain agriculture is a consequence of augmented environment degradation. While the productivity of mountain farmland has been gradually declining, impoverishment among mountain farmers has gradually risen because of the depleting resource-base. Some studies hold that, within the present socioeconomic situation, agricultural development on the basis of traditional crops is not possible. A few studies suggest that future agricultural development in mountain regions is possible through production of high-value cash crops, especially horticulture, which will also help in maintaining environmental sustainability. No study of agricultural diversification in the mountain region using the farming systems approach exists till now. Against this backdrop, the present research study proposes to investigate the role of agricultural diversification in agricultural and rural development in the study region, as the possible basis for a future mountain development strategy.

2.5.2 Prospects and Practice of Rural Livelihood Diversification

Farming systems that exist in mountain regions have been shaped over time by three broad interactive forces, namely

(i) biophysical characteristics that orient mountain resource-use in peculiar directions and patterns,

(ii) indigenous resource-use and resource management practices that have evolved after centuries of adaptive experience, and

(iii) public interventions designed to guide mountain resource-use into prescribed directions and patterns *(*Sharma and Jodha, 1992*).*

Because of these features, mountain farming regions in the tropics and subtropics show extraordinary crop-diversity in keeping with environmental and biophysical diversity, and the ethnocultural diversity of the resident population coupled with the relative antiquity of their agricultural practices. Mountain farming systems also display a wide range of systemic and human adaptations to peculiar constraining phenomena such as physical inaccessibility, ecological fragility, diversity and marginal scale of activity, as well as to the localised comparative advantage created by their distinct production nichês.

Agricultural development in mountain regions is subject to limitations in transport & communications, market infrastructure. Because of the wide variation in microclimates, modern farm inputs and technologies are often inapplicable. Potential socioeconomic pressures would also arise if the rural situations in plains areas were duplicated, with a preponderance of large families living on small fragmented farms. In the face of such real and potential impediments, mountain farmers have commonly

resorted to subsistence-oriented mixed farming modes characterised by substantial diversification of activities and a high degree of self-reliance. Conjunctive agriculture combined with livestock farming and horticulture is usually the most important rural livelihood source in mountain regions (Yadav, 1992; Tulachan, 2001). Because of low agricultural productivity overall, livestock farming forms an important subsidiary means of subsistence in drier mountain zones, where cultivation of foodgrains and other crops is difficult. Thus, animal husbandry is often the mainstay of rural livelihoods in the more underdeveloped areas. Since strong two-way linkages exist between animal husbandry, horticulture and crop-farming, participants in mountain farming systems generally have fairly large holdings of bovine livestock to meet the needs for milk, manure and draft-power. Flocks of ovine animals such as sheep and goats partially meet their need for meat and warm clothing, besides functioning as insurance assets which can be quickly sold off in times of need. Nevertheless, livestock-farming is one of the most mismanaged sectoral activities in mountain regions. A major part of overgrazing and deforestation problems in such regions can be attributed directly to rapid growth of the livestock population.

Horticulture has gradually become a leading sector of activity associated with agricultural regions in mountain areas, because of its strong economic linkages with external distribution systems, market development and technological support. Horticulture has exclusive growth potential in mountain nichês upto the altitude of 2500m, where horticultural enterprise in growing mushrooms, cut-flowers and miscellaneous fruit as well as exotic and off-seasonal vegetables is widely perceived to hold the key to future rural prosperity **(**Bhati *et al*., 1992**;** Chand, 1996a).Thus, the expansion of horticultural activity has introduced a new form of diversification within the mountain farming system which not only utilises the diversity of mountain production environments to economic advantage, but also accommodates the modernised format of market-oriented agriculture.

Besides agriculture, animal husbandry and horticulture, which are the principal interrelated activities in mountain farming, certain areas in the study region also depend on plantation activities involving the organised cultivation of tea, cinchona and so on. Agroforestry also occupies an important place in the rural livelihood system as it serves the fuelwood, fodder and timber needs of the mountain population. Given the importance of these constituents in rural economic activity, the study will examine the existing rural livelihood patterns in the study region vis-à-vis the strategic scope for economic development through rural livelihood diversification. The study will then show that immense scope for diversification exists within the crop-sector through shifts from the production of low-value to high-value crops, exotics and off-seasonal horticultural crops, etc. which better utilise the favourable agroclimatic and nichê production advantages of mountain regions. Besides such on-farm livelihoods, the prospect for off-farm livelihoods as a basis for future diversification into rural non-farm and agro-based activities will also examined. It is felt that these complementary development paths can secure a better economic future for residents of the study region without imposing undue strains on the mountain environment.