Hypotheses on inland valley development for smallholder dairy production in three West African countries Côte d'Ivoire, Mali and Nigeria

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Summary

A set of pre-formulated hypotheses about the potentials of inland valleys to agricultural production in general, and livestock (dairy) - based enterprises in particular, were tested with data collected from five regions comprising 71 villages/towns and 630 households in three countries (Nigeria, Mali and Côte d'Ivoire). The study was undertaken to test hypothesis concerning the potentials of the inland valleys systems to agricultural production, and those pertaining to the intensification of livestock production in the valleys systems and their relationships with demand for livestock (dairy) products.

Results from the analysis showed that many of the previously held views about inland valley and their potential were supported by the data from the three countries. Most of the hypotheses relating directly with inland valley potentials were accepted in the majority of locations. However, there were few hypotheses which were not supported by data from all countries and study sites. The overall assessment from the surveys is that the potentials of the inland valleys towards dairy production are currently good in all the countries and could be better if the resources available in the inland valley environments (for example crop residues) are better managed and utilized. Intensive use of inland valleys was related more to population density than access to market. Similarly consumption levels of domestic dairy products were influenced by population concentration. Instead access to market influenced positively farmers' practices towards specialization and intensification of dairy production. Increase demand for milk and dairy products is met by intensification and not by increase in herd size. Efforts to ensure continued milking through feeding was not related to herd size. As revenues (sales and home consumption) increased, more lands were left to fallow. These results confirm the assertion that the presence of inland valley systems for cropping and livestock rearing promotes diversification of agriculture, and presumably reduces farmers' production risks.

Keys words: inland valleys, potentials, cattle, dairy production, West Africa

Introduction

Livestock are important for rural communities and particularly for small-scale farmers in developing areas in Africa. For many years livestock departments have attempted to improve the lives and productivity of rural communities' livestock owners. Although the most common problems relate to nutrition (availability and quality of feed), and to diseases, many

development programmes concentrate on specific aspects, such as disease control. In reality there is a need to integrate different components to ensure that sustainable systems of production are established. These involve both crop and livestock production in complex small-scale farming systems.

Inland valleys which are defined as the upper reaches (including valley bottoms and valley fringes) of river systems, with respect to the main rivers and the main tributaries, have high potential in contributing to intensive development and sustainable agriculture because of the relatively high soil fertility and residual moisture during the dry season. That relatively high fertility results from sedimentary deposits originating from lateral erosion process from adjacent slopes or uplands (Raunet 1982; Moormann and van Breemen 1978).

It is hypothesized that of all the agricultural subsystems that exist or potentially exist in the lowlands, those associated with the inland valleys are better placed to respond fastest to development and intensification, as driven by both population and markets. This is evident from the fact that, in sub humid and semi-arid West Africa, many centres of large population are either sited in, or borders of inland valley systems. These population centres are urban and possess higher than average incomes to support larger demand for food including livestock products, particularly dairy products. It has also been noted that the most intensively used inland valleys are near large settlements where crossbreeding with European breeds has been widely used to improve dairy production in most countries. Despite theses facts, few studies have been conducted to confirm or reject these hypotheses. Earlier efforts on the inland valley development in West and Central Africa emphasized crop and resource management technologies for systems with full water control (Oosterbaan 1986). However, on-farm economic evaluation of complete water control systems in inland valleys of northern Nigeria showed unattractive economic returns (Ashraf et al 1988).

In the view to provide tools to development programmes to better assist the farmers to manage their livestock more effectively this study was undertaken with the aim of testing hypothesis concerning the potentials of the inland valleys systems to agricultural production, and those pertaining to the intensification of livestock production, particularly dairy production, in the valleys systems and their relationships with demand for livestock (dairy) products.

Material and methods

A two-level (village/town, household level) characterization of inland-valley areas was undertaken in order to provide an overview of the potentials and constraints associates with inland-valleys agriculture production in a crop-livestock system of Côte d'Ivoire, Mali, and Nigeria. User groups and opinion leaders in 71 villages and towns and over 630 farm households were surveyed. The study sites were Zaria and Kufana in Kaduna State in Nigeria, Bouaké and Korhogo in Côte d'Ivoire, and Sikasso in Mali. Characteristics of the inland-valley systems in these sites and their description have been reported by Agyemang et al (2006).

The data from the two surveys were linked to provide information needed to test some pre-formulated hypotheses (Rey et al 1996), in order to quantify some of the results obtained from group (village level) and individual household's interviews. For each hypothesis, the associated questions and responses to the questions and the variables to be used were

assembled. In some cases new variables that would require information from the semi and detailed data sets were constructed. The two data sets were linked through the village or town name on both data sets. Hypotheses and their status of acceptance or rejection were tested by the use of t-test to compare means of two classes (or F-test for more than two classes) and Pearson correlation coefficient (r) for variables assumed to have continuous distribution while chi-square tests (c^2) were used for data that were presented in contingency tables.

Results

Land accessibility for agricultural production

Hypothesis (Ho): Farm household with access to inland valleys in addition to uplands have more income, more food security and better general well-being than those with access only to uplands

Data on the gross value of food crops and livestock products produced (home consumption and sales) by farm households in the drier parts of the northern guinea savannah zone, (represented by the Zaria region of Kaduna state of Nigeria) with access to both inland valleys and uplands and those with uplands only were compared. The results showed that the former group had a higher gross income (Nigerian ₦ 226,166 (1,766$US) vs. ₦122,944 (960$US); P < 0.001). [1 $US = 128.05 Nigerian ₦].

This result was also true (P<0.001) for the wetter part of the northern guinea savannah zone represented by the Kufana area (Table 1).

1. Hypotheses pertaining to land accessibility

hesis (H_o)	Variables analyzed	Key Class/ Grouping used	Test Type	Country/Region	Accept	F
	-Total money value of crops grown and milk produced	-Land Access	t	Nigeria: Zaria	*	
				Kufana	*	
				Mali: Sikasso	*	
				Côte d'Ivoire: Korhogo		
				Bouaké		
	-Number of farm enterprises	-Land Access	t	Nigeria: Zaria	*	
				Kufana	*	
				Mali: Sikasso	*	
				Côte d'Ivoire: Korhogo	*	
				Bouaké	*	
	-Fallow ratio= cultivated inland valleys plots + upland plots to total land	-Land Access	t	Nigeria: Zaria	*	
				Kufana		
				Mali: Sikasso	*	
				Côte d'Ivoire: Korhogo		
				Bouaké		

hesis (H_o)

Farm Households (crops and livestock) with access to inland Valleys in addition to uplands have more INCOME, more food security and general ing than those with access only to uplands.

Farm Households with access to inland valleys link up more farm enterprises than those with no access to inland valleys.

Farm Households who crop in Inland Valleys in addition to upland practice longer fallow periods on their upland plots than those who do not use In

1. Hypotheses pertaining to land accessibility

hesis (H_o)	Variables analyzed	Key Class/ Grouping used	Test Type	Country/Region	Accept	R

s.

Similarly, in the Sikasso region of southern Mali, this hypothesis was accepted (Table 1), as average farm incomes were FCFA[2] 960,114 ($US 1,980) for those who cropped both inland valley and upland plots, and only FCFA 302,213 ($US 625) for those who cropped on uplands only ($P < 0.001$). In the context of Sikasso the differences in incomes were largely due to incomes generated from cultivation of potatoes on inland valley plots during the dry season, and the value of milk for those who milk their cows. In contrast the hypothesis was rejected in both the Korhogo and Bouaké regions of Côte d'Ivoire as the average farm income of those with access to inland valley and upland plots in Bouaké, although numerically larger than those with upland plots only (FCFA 1,476,634 ($US 3,045) vs FCFA 808,272 ($US 1,667)) but statistically not significant ($P>0.15$). [1 $ US = 483.52 FCFA].

Hypothesis (Ho): Farm households with access to inland valleys link up more farm enterprises than those with no access to inland valleys

This hypothesis was accepted in all the study sites of the three countries (Table 1). In both the Zaria and Kufana regions of Nigeria, the average numbers of farm enterprises (number of crops grown, types of livestock kept, milking of herd, use of animal traction, etc) were higher for households with access both to inland valleys and upland plots than those with access only to upland plots, 10.0 vs. 7.4 ($P < 0.001$) for Zaria, and 8.1 vs 7.2 ($P<0.04$) for Kufana. In Bouaké (4.9 vs. 3.5, $P<0.05$) and in Korhogo (5.9 vs. 4.3) in Côte d'Ivoire, farmers with access to both inland valley and uplands tended to have more cattle than those with access to uplands only (137 vs. 100). In Mali (Sikasso), those farmers who cropped both inland valley and uplands had an average of 6.0 enterprises compared with 4.8 for those who cropped only on uplands ($P<0.01$).

Accessibility to market and farm activity intensification

Accessibility to markets proved to be important in maximising benefits from inland valley agriculture. In contrast, some held views about the role of markets on dairy production and marketing were not supported by the data from the study. All hypotheses about the market accessibility in relation with the intense use of inland valleys and the marketed surplus were rejected (Table 2).

Table 2. Hypotheses pertaining to market accessibility

Hypothesis (Ho)	Variables analyzed	Key Class / Grouping used	Test Type	Country/Region	Accept	Reject
1	-Inland valleys land size cultivated	-Market Access	t	Nigeria: Zaria		*
				Kufana		*
				Mali: Sikasso		*
				Côte d'Ivoire: Korhogo		*
				Bouaké		
1	-Ratio of inland valleys land	-Market Access	t	Nigeria: Zaria		*
				Kufana		*
				Mali: Sikasso		*

				Côte d'Ivoire: Korhogo	*
				Bouaké	
2	-Ratio of dairy product sale to total production	-Market access	t	Nigeria: Zaria	*
				Kufana	
				Mali: Sikasso	
				Côte d'Ivoire: Korhogo	*
				Bouaké	

Hypothesis (H_o)
1. The closer to markets or the easier the accessibility to markets the more intense the use of Inland Valleys.
2. Market accessibility influences the ratio of marketed surplus (sales/production).

Population sizes in relation with farm activity intensification

Hypothesis (Ho): The higher the human population of a village or town, the more intense use of inland valleys.

The hypotheses on human population concentration in relation to proportion of farmers using inland valleys and money value of crop produced were accepted. Chi-square tests on population classes by land type accessibility (Table 3) in Zaria region showed that as population increased, the proportion of farmers with access to upland plots only decreased ($\chi^2 = 9.39$, $P < 0.01$) as more farmers moved to have access to inland valleys.

Table 3. Hypotheses pertaining to population sizes

Hypothesis (Ho)	Variables analyzed	Key Class/ Grouping used	Test Type	Country/Region	Accept	Reject
1	-% or Proportion	- Population class -Land access	c^2	Nigeria: Zaria	*	
				Kufana	*	
				Mali: Sikasso		
				Côte d'Ivoire: Korhogo		
				Bouaké		
1	-Crop yield per hectare	- Population class	t	Nigeria: Zaria		*
				Kufana	*	
				Mali: Sikasso		
				Côte d'Ivoire: Korhogo	*	
				Bouaké		
1	-Value of crop per hectare	- Population class	t	Nigeria: Zaria	*	
				Kufana	*	
				Mali: Sikasso		
				Côte d'Ivoire: Korhogo	*	
				Bouaké		

Hypothesis (Ho)
1. The higher the human population of a village the more intense is the use of inland valleys.

Whereas 92% of respondents in the more densely populated villages in the Kufana area use inland valley plots, only 57% did so in less densely populated villages. In general farmers in

less densely populated villages (<5000 people) obtained higher crop yields/ha than those in highly populated (>5000) villages (1.4 vs. 0.80 t/ha, P < 0.01) from inland valley plots. However, the money value of crops grown in both densely and sparsely populated villages were about the same (₦45,390 ($US 354) vs. ₦58,521 ($US 457) /ha; P >0.10), implying that higher value crops are grown in those inland valleys in more densely populated town/villages than in sparsely populated towns/villages. In the Kufana area both the crop yield per ha of cultivated inland valley plot and the money value of the crops were larger in densely (1984 kg/ha; ₦200,945 ($US 1569)/ha) than less densely populated locations of Côte d'Ivoire (1029 kg/ha; ₦108,911 ($US 850) /ha). Similar observations were made in the Korhogo region where yield per ha of inland valley land used in towns/villages with population greater than 1000 was higher (2645 vs. 1410 kg /ha) than those settlements with population less than 1000 (P<0.05), in spite of similar hectarage cultivated (1.11 vs 1.45 ha).

Demand / Consumption of dairy products and intensification of production

Hypothesis (Ho) Consumption levels of marketed domestic dairy products is positively correlated with population concentration

This hypothesis is accepted only in Zaria and Sikasso areas (Table 4).

Table 4. Hypotheses pertaining to dairy products consumption and to intensification of dairy production

Hypothesis (H_o)	Variables	Key Class/ Grouping used	Test Type	Country/Region	Accept	Reject
1	-Dairy product consumed per household	-Human population classes	Pearson correlation	Nigeria: Zaria	*	
				Kufana		
				Mali: Sikasso	*	
				Côte d'Ivoire:		
				Korhogo		
				Bouaké		
2	-% or Proportion	-Market access -Management strategies	c^2	Nigeria: Zaria	*	
				Kufana		
				Mali: Sikasso	*	
				Côte d'Ivoire:		
				Korhogo		*
				Bouaké	*	
3	-% or Proportion	-Herd size -Management strategies	c^2	Nigeria: Zaria	*	
				Kufana	*	
				Mali: Sikasso	*	
				Côte d'Ivoire:		
				Korhogo		*
				Bouaké		
4	-Value of crops -Land size cultivated -Grazing land		Pearson correlation	Nigeria: Zaria	*	
				Kufana		
				Mali: Sikasso		
				Côte d'Ivoire:		
				Korhogo	*	

Table 4. Hypotheses pertaining to dairy products consumption and to intensification of dairy production

Hypothesis (H_o)	Variables	Key Class/ Grouping used	Test Type	Country/Region	Accept	Reject
				Bouaké	*	
5	-% or Proportion	-Dairy production constraints	c^2	Nigeria: Zaria	*	
				Kufana		
				Mali: Sikasso	*	
				Côte d'Ivoire:		
				Korhogo	*	
				Bouaké		

Hypothesis (H_o)

1. Consumption levels of marketed domestic diary products is positively correlated to population concentration

2. As access to markets at the farm gate increases, farmer's practices change towards specialization and intensification of dairy production.

3. Increased demand for milk and dairy products is being met by the intensification of production, not by an increase in herd size.

4. As food crop production increases, more land is allocated to livestock enterprises (forage production).

5. Farmer's ranking of constraints to increased dairy products varies when intensification takes place.

When household size (members) was used as a proxy for human density, the correlation was positive and significant ($r = .37$, $P <. 001$, $n = 108$) for the Zaria region. When three village population classes, 500-1000 (low), 1001-5000 (high) and very high (<5000) were considered, the respective correlation coefficients were 0.38 ($P < 0.05$), 0.66 ($P < 0.001$) and 0.05 ($P > 0.10$). Similar trends were observed in the Sikasso region of Mali, indicating that at very high population densities inadequate supply of dairy products may negatively influence the consumption rates.

Hypothesis (Ho): As access to markets at the farm increases, farmer's practices change towards specialization and intensification of dairy production

This hypothesis was accepted (Table 4) for the Zaria region where farmer's strategies in meeting feed shortages were analyzed. Proportionately larger number of households opt to purchase feeds when faced with feed shortages in easily accessible market areas than those in areas where markets were not easily accessible ($\chi^2 = 18.6$, $P < .001$). Similarly, proportionately larger number of households in areas where markets were easily accessible provided more protected and secured feed storage facilities when compared with those in areas where market accessibility was poor ($\chi^2 = 17.7$, $P < .001$). However in the Korhogo region, the proportion of farmers in market accessible locations who purchased feed for supplementary feeding to livestock was similar to those settlements in not easily accessible markets (90% vs. 86%). In the Bouaké region all locations were considered to be within easily accessible markets and nearly every livestock owning household (98%) purchased animal feeds.

Hypothesis (Ho): Increase demand for milk and dairy products is being met by intensification and not by increase in herd size

Increase demand for milk and dairy products is being met by intensification and not by increase in herd size in Zaria, Kufana and Sikasso (Table 4). When cattle herd size were

categorized into small (<10), medium (10-50) and large (>50) and the distribution of farm households who stored and used feeds from the preceding wet season to supplement milking cows in the dry season were analyzed, 60% of respondents households in Zaria region had small herds, while only 21% had large herds ($\chi^2 = 15.2$, P = .018), indicating that efforts to ensure continued milking through feeding was not related to herd size. Similar patterns were obtained for feed purchases relative to other measures for meeting feed shortages ($\chi^2 = 24.4$; P < 0.001). In the Kufana region, 70% of households with small herds purchased feeds compared with 30% households with large herd size. On the contrary with the Korhogo region, there was a tendency towards larger proportions of farmers to purchase feeds as the herd sizes increase, for example, 5%, 35% and 60% for low, medium and large herd sizes, respectively.

Hypothesis (Ho): As food crop production increases, more land is allocated to livestock enterprises (e.g. for fodder/forage production and use)

In the Zaria region total value for crop production was positively and significantly correlated with fallow lands available for grazing (r = .30, P < .0001, n = 200) suggesting that as revenues (sales and home consumption) increased, more lands were left to fallow. This observation was also true in the Korhogo region of Côte d'Ivoire where a highly significant correlation between total value of food crops and grazing land (r = .42, P < .001) was observed. In the Bouaké region a direct correlation (r=0.63, P<.01) was observed between size of cropland and grazing land (Table 4).

Dairy cattle feeding

All three hypotheses related to cattle feeding (Table 5) were rejected.

Table 5. Hypotheses pertaining to dairy cattle feeding

Hypothesis (H_o)	Variables	Key Class/ Grouping used	Test Type	Country/Region	Accept	Reject
1	-Income per tropical livestock unit	-Use of rented fields	t	Nigeria: Zaria Kufana Mali: Sikasso Côte d'Ivoire: Korhogo Bouaké		*
1	-Income per tropical livestock unit	-Use of rented inland valleys plots	t	Nigeria: Zaria Kufana Mali: Sikasso Côte d'Ivoire: Korhogo Bouaké		*
2	- Intensification ratio	-Use of purchased feed	t	Nigeria: Zaria Kufana Mali: Sikasso Côte d'Ivoire: Korhogo Bouaké		* * *
3	-Crop residue		Pearson	Nigeria: Zaria		*

Table 5. Hypotheses pertaining to dairy cattle feeding

Hypothesis (H_o)	Variables	Key Class/ Grouping used	Test Type	Country/Region	Accept	Reject
	quantity - Intensification ratio		correlation	Kufana		*
				Mali: Sikasso		*
				Côte d'Ivoire: Korhogo		
				Bouaké		

Hypothesis (H_o)

1. Milk Producers who rent crop residue fields which include fields in inland valleys achieve higher income per Tropical Livestock Unit (TLU) owned as compared to milk producers who rent only upland crop residue fields.

2. Lack of access to agro-industrial by-products is a factor limiting dairy intensification.

3. The higher the use of crop residue in a smallholder dairy, the lower the level of intensification of that enterprise.

Farm income remained the same whether or not the farmers rented crop residue from inland valley alone or both inland valley and uplands. Similarly the lack of access to agro-industrial by-products was not found to be a limiting factor to dairy intensification.

Disease incidence

Hypothesis (Ho): Patterns of disease incidence change as dairy production intensifies

The proportions of farm households in the Zaria region of Nigeria who identified trypanosomosis, diarrhoea and skin problems differed ($\chi^2 = 28.7$, $P<0.01$) when categorized by level of intensification, low (0-3), medium (4-9) and high (>9). Similarly, in Sikasso region of Mali, the hypothesis was accepted (Table 6) with respiratory diseases including pneumonia being the disease associated with highest intensity ratio and skin problems associated with the least intensified herds.

Table 6. Hypotheses pertaining to animal health

Hypothesis (H_o)	Variables	Key Class/ Grouping used	Test Type	Country/Region	Accept	Reject
1	- Intensification ratio	-Availability of vet. services	t	Nigeria: Zaria		*
				Kufana		*
				Mali: Sikasso		*
				Côte d'Ivoire: Korhogo		
				Bouaké		
2	-% or Proportion	-Disease categories - Intensification ratio classification	c^2	Nigeria: Zaria	*	
				Kufana		
				Mali: Sikasso	*	
				Côte d'Ivoire: Korhogo		
				Bouaké		

Hypothesis (H_o)

1. Availability and utilization of veterinary services for preventive interventions increase with intensification.

2. Patterns of disease incidence change as dairy production intensifies.

Discussions

The data showed that the view that the use of inland valleys does provide diversification for agricultural production is largely correct as producers with these resources had more enterprises and more gross incomes. The superior gross value for food and dairy products for those with access to both inland valleys and uplands over those without access to inland valleys could be explained by the more diversified production by the former group made possible by residual moisture. The gross value of crops in Kufana zone (Naira (~~N~~) 326,727 ($US2551) vs. 151,262 ($US 1181)) was larger than in the Zaria area, presumably because of higher production made possible by better rainfall in the latter region, which averages 1,200 mm per annum. Rainfall has a direct effect on grass production and quality, but its effect on animals is indirect through grazing.

When concentrates for dairying in rural areas are unavailable due to the cost and logistical problems of procurement (Dugmore et al 2004), the strategy of using legume tree base crop-livestock production (Jabbar et al *199*6) or producing fodder (Nsoso and Madimabe 2003), may be an attractive option for dry season feed shortage. Gross financial return, when all the tree foliage was used for feeding dairy cows, was 3.3 times higher in an experiment conducted in sub-humid coastal Kenya (Reynolds and Jabbar 1994). Crop residues are also valuable source of animal feed and utilizing the residues by grazing is very effective in returning plant to the soil. However crop residues are low quality feeds and cannot be used alone for high producing animal such as lactating cows (Gertenbach and Dugmore 2004). Feed resources from the cropping systems, particularly crop residues appears widespread but current strategies in their collection storage and use appear not sound in some of the locations surveyed especially in view of the fact that storage of feeds and fodder for livestock was ranked high, together with animal health as major constraints to increased livestock production (Agyemang *et al* 2006.)

Fallow ratio on available land was larger in majority of situations for those using inland valleys. Accessibility to markets proved to be important in maximizing benefits from inland valley agriculture. In contrast, some held views about the role of markets and use of certain resources on dairy production and marketing were not supported by the data from the study. For example, the hypothesis that the extent use of crop-residues in smallholder dairying is a negative factor on intensification was not found to be the case as there was heavy reliance on this resource. Market imperfection, such as lack of information in rural areas, geographic dispersion of extension agents and poor infrastructure and communication, are found responsible for hampering the marketing of agriculture products for small scale producers (Sautier and Biénabe 2005).

As access to market increases farmers did not intensify the use of inland valley nor influence ratio of marketed surplus (Table 2). Instead as access to market increases farmers tend to specialize and intensify their dairy production (Table 4). Farmers need to be more efficient and effective entrepreneurs in order to take advantage of new market opportunities (Schreiber 2002). To move from subsistence to market-oriented production farmers will need new technologies and information on how to access, understand and manage their production factors. These production factors should include artificial insemination, health care and milk collection. In a case study in Kenya, dairy farmers located far from market centers found improved pasture and fodder crops and feed conservation were the key factors for innovation (Schreiber 2002). Cooperative and private companies which are market oriented actors were the most important source of innovation for the professionally operated dairy farms in Kenya

(Schreiber 2002). The cooperatives serve as marketing channels and as mediators between the farmers and the markets.

Access to densely populate urban market for milk and other dairy products provides farmers with opportunities to intensify their production and increase their income, as the consumption level of dairy products and population concentration were positively correlated in the region of Zaria, Nigeria and Sikasso, Mali. The degree of access to market affects farmers' opportunities to adopt new technologies. Long distance from market centers appears to be an unfavorable environment for dairy intensification. Similarly poor infrastructure prevents market from developing.

Demand for milk and other dairy products were not met by increasing herd size but by dairy production intensification (Table 4) in Zaria, Kufana and Sikasso. Kenyan professionally intense operated farms reduce their stocking rate, resulting in further specialization in milk production (Schreiber 2002). Level of intensification of dairy production or measures to achieve it were found not to be related to size of herds. However, as intensification occurs, farmers' ranking of constraints was found to differ. The extent of variation however was dissimilar in the five regions studied; the access to market and the population densities seem to be the basis of this variation.

Conclusion

Results from the synthesis showed that many of the previously held views about inland valleys and their potentials were supported by the data from the three countries Côte d'Ivoire, Mali and Nigeria). However, there were few hypotheses which were not supported by data from all the countries and study sites. These results confirm the assertion that the presence of inland valley systems for cropping and livestock rearing promotes diversification of agriculture, and presumably reduces farmers' production risks.

Accessibility to markets and level of marketing of dairy and other livestock products, as well the level of integration of various agricultural enterprises showed that, the various sites within a given country and the countries were at different stages in the development and utilisation of inland valleys and their resources. The valley systems closer to urban centres (Sikasso in Mali, Zaria in Nigeria) dairy production was an important activity, perhaps reflecting the often found linkages between higher consumption of dairy products and urbanised populations. The increased in demand for livestock products often act as a pull on production, therefore raising the prospects that the dairy potential in highly populated inland valley areas could be exploited. . Results from this study provide farmers with necessary information that could be use as decision tools to improve their agriculture production in the inland valley system.

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