Report of the Agrobiodiversity Baseline Survey in Western Rajasthan, India

Introduction

As part of the implementation of the Dryland Systems CRP in South Asia, Bioversity International with funding support from ICRISAT, and in collaboration with GRAVIS and CAZRI carried out an Agrobiodiversity Baseline Survey (ABD-BS) in 8 villages across three SRT2 districts of Rajasthan. The baseline focused on the diversity of domesticated plant species grown by households on farm, home gardens and community lands; it also included data on domesticated animals and useful crop wild species. The survey included both qualitative and quantitative methods at community and household levels. The aim of the assessment was to provide a broad inventory of the species diversity used in the specific systems targeted by the CRP1.1, which can be related to indicators of wellbeing, socioeconomic characteristics, loss of diversity and challenges faced by target households. The baseline collected information on:

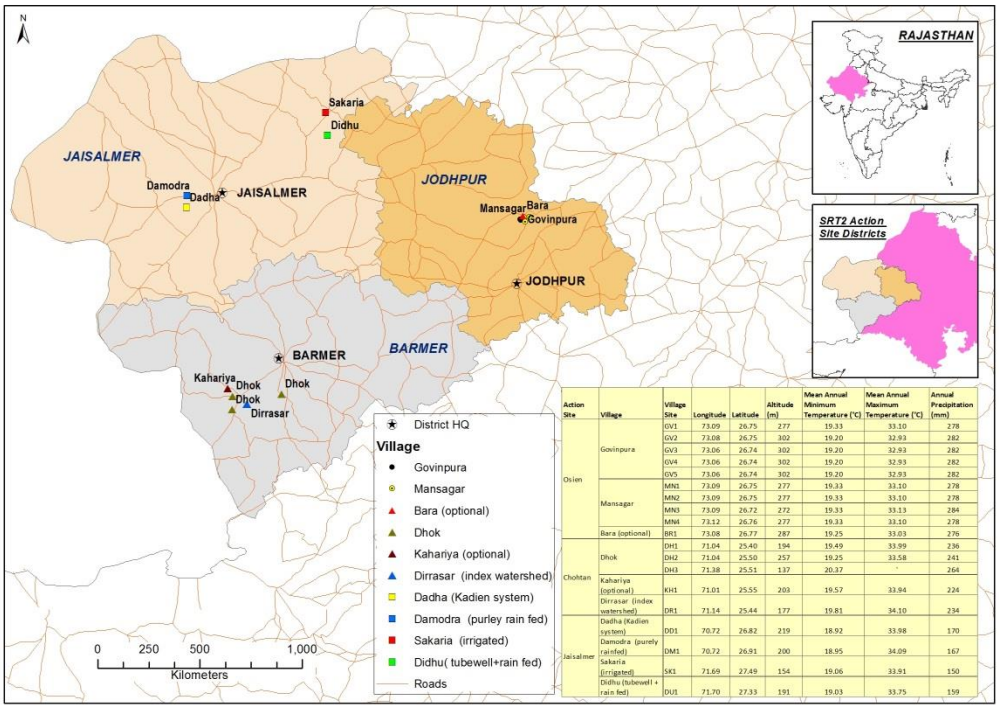
1. The diversity of domesticated plant species grown on farm and home gardens and of domesticated animal species kept on the farm
2. The diversity of domesticated and wild plant and animal species present in diets and markets
3. Characterization of the objectives of production and uses for identified species
4. Characterization of the seed systems associated with key crops grown (both informal and formal)
5. Gender aspects of the management and uses of the diversity of identified species
6. Risk consideration associated with the diversity of identified species
7. Key socioeconomic and food security data

The knowledge generated by the ABD-BS will be the basis for identifying entry points for designing and implementing interventions that contribute to improve their well-being of rural households in action sites.

Table 1. Villages where the ABD-BS took place in Rajasthan

DISTRICT	BLOCK	VILLAGE
JODHPUR	BAWARI	MANSAGAR
JODHPUR	BAWARI	GOVINDPURA
BARMER	CHOUTAN	Dhok
BARMER	CHOHTAN	Dirrasar
JAISELMER	SAM	DEDA
JAISALMER	SAM	DAMODARA
JAISELMER	JAISELMER	DEDHU
JAISELMER	NACHANA	SHAKADIYA

Figure 1: SRT2 Action Site Locations in Rajasthan

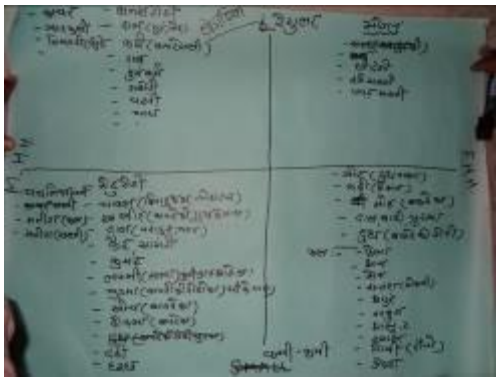


Action Site	Village	Village Site	Longitude	Latitude	Altitude (m)	Mean Annual Minimum Temperature (°C)	Mean Annual Maximum Temperature (°C)	Annual Precipitation (mm)
Oslen	Govinpura	GV1	73.09	26.75	277	19.33	33.10	278
		GV2	73.08	26.75	302	19.20	32.93	282
		GV3	73.06	26.74	302	19.20	32.93	282
		GV4	73.06	26.74	302	19.20	32.93	282
		GV5	73.06	26.74	302	19.20	32.93	282
	Mansagar	MN1	73.09	26.75	277	19.33	33.10	278
		MN2	73.09	26.75	277	19.33	33.10	278
		MN3	73.09	26.72	272	19.33	33.13	284
		MN4	73.12	26.76	277	19.33	33.10	278
	Bara (optional)	BR1	73.08	26.77	287	19.25	33.03	276
Chohtan	Dhok	DH1	71.04	25.40	194	19.49	33.99	236
		DH2	71.04	25.50	257	19.25	33.58	241
		DH3	71.38	25.51	137	20.37	-	264
	Kahariya (optional)	KH1	71.01	25.55	203	19.57	33.94	224
	Dirrasar (index watershed)	DR1	71.14	25.44	177	19.81	34.10	234
Jaisalmer	Dadha (Kadien system)	DD1	70.72	26.82	219	18.92	33.98	170
	Damodra (purely rainfed)	DM1	70.72	26.91	200	18.95	34.09	167
	Sakaria (irrigated)	SK1	71.69	27.49	154	19.06	33.91	150
	Didhu (tubewell + rain fed)	DU1	71.70	27.33	191	19.03	33.75	159

Activities

For the ABD-BS two main activities were implemented: (1) focus group discussions and (2) household surveys. Two types of focus group discussions were carried out in each village simultaneously. One elicited information on the useful biological diversity grown or harvested in the production system (on farm, common lands, and wild) and markets that the households in the community attend. The second elicited information on the dietary diversity. Participants in both type of groups included both man and women, if necessary the groups were separated by gender. The household survey was implemented with 30 households per village, for a total of 239 households since in one village there was one missing household. It included the same households that participated in the ICRISAT baseline survey, so the data can be linked across surveys.[1] The survey was divided into two questionnaires. One elicited information on biological diversity, markets and general socioeconomic information. It was applied to the head of the household and spouse together. The second one elicited information on dietary diversity using a 7 day food frequency recall questionnaire. It was applied to by woman in the household between 15 and 49 years of age that is the mother of at least one child between 6 to 59 months. If no children in that age group were present, the questionnaire was applied to the women that customarily prepared the food only. The data on food diversity refers specifically to the mother and child (or women who prepares the food) and not to the household. In addition the respondent to the dietary diversity questionnaire also provided information on food security for the household.

[1] Data were collected in all villages where ICRISAT conducted its baselines survey. However, due to some mix up in the data provided for the analysis, in this report we analyzed the data of two adjacent villages in Badmer: Artiya and Dudhadia instead of Dhok and Dirrasar. The data from the latter villages is being incorporated in the analysis.



Focal Group Discussion in Jodhpur

Results

Diversity of domesticated plant species grown on farm, objectives of production and uses

Even in these dry environments there is an important diversity of crops, trees and bushes that are grown or maintained on farm. Table 2 shows that 18 annual domesticated species were grown by households across the eight villages studied during 2012 (the reference year for the survey). The most commonly grown were pearl millet, cluster bean, moth bean and green gram. Only the first two species were grown by more than 50% of households, while half of the species (9) were grown by 10% or less. On average households grew 4.5 species, but some may grew up to 10; only one fifth of the households grew 3 species or less.

Table 2. Annual domesticated species grown by households in studied villages during 2012 (number of households that produced the crop and number of villages where the crop was produced)

Species	Common name	No. households	No. villages
Allium cepa	Onion	1	1
Arachis hypogea	Peanuts	2	1
Brassica spp	Mustard	27	5
Cicer ariatinum	Chickpea	78	4
Citrullus lanatus	Water melon	50	4
Cucumis sativus	Cucumber	50	3
Cuminum cyminum	Cumin	11	4
Cyamopsis tetragonoloba	Cluster bean	182	8
Gossypium hirsutum	Cotton	9	2
Pennisetum glaucum	Pearl millet	227	8
Plantago ovata	Psyllium	1	1
Praecitrullus	Round gourd	1	1
Ricinus communis	Castor	21	3
Sesamum indicum	Sesame	24	5
Sorghum vulgare	Sorghum	8	1
Triticum aestivum	Wheat	88	5
Vigna aconitifolia	Moth bean	138	7
Vigna radiata	Green gram	120	8

In terms of perennial species maintained on farm, kitchen garden or common lands by households, Table 3 shows also 18 species. *Prosopis cineraria*, also known as "tree of life", was the most common species maintained by households in all villages, followed by *Ziziphus nummularia, Calotropis gigantia* and *Tecomella undulata* which were maintained by about a third of households in most of the villages. On average households maintained 3.7 perennial species per household and up to 9. In total, between annual and perennial species, farmers managed on average 8.2 species, with a maximum of 16.

Table 3. Perennial species maintained on farm, kitchen garden or common lands by households in studied villages (number of households that produced the crop and number of villages where the crop was produced)

Species	No. households	No. villages
Acacia arabica	79	5
Acacia nilotica	43	6
Areca catechu	18	2
Azadirachta indica	61	7
Calotropis gigantia	74	5
Clerodendrum multiflorum	29	1
Cordia dichotoma	10	3
Eucalyptus citriodora	2	2
Leptadenia pyrotechnica	21	2
Mangifera indica	1	1
Prosopis cineraria	225	8
Salvadora oleiodes	43	4
Senegalia catechu	53	5
Tamarindus indica	1	1
Tecomella undulata	72	5
Ziziphus mauritiana	60	5
Ziziphus nummularia	81	6

For most annual species, self-consumption was the most common objective of households for most, being either the sole objective or combined for production for the market (Table 4). Exclusive production for the market was the least common in terms of number of species and households. In terms of the contribution of the species to household food supply or income—based on a subjective rating by the survey respondents—pearl millet was the most commonly grown species with the highest contribution to food supply. Cluster bean provided the highest contribution to income, but it was also important for food, followed by chickpea with a similar pattern. It should be pointed out that the chickpea grown in Rajasthan is *desi* type and not the *Kabuli* type. Cucumber and water melon were the most commonly grown species exclusively for self-consumption and they made a high contribution to food supply. Moth bean, green gram and wheat were widely grown and made an important contribution to food supply. There were a few species that while grown by few households were important for income, such as mustard, castor, cotton and castor.

Table 4. Objective of production of annual species (number of households that stated the objective for a species, both objectives could have been stated by the same household) and subjective mean rating of the contribution of each species to the food supply and income of the household

s	Objective			Contribution to	
Species	Self	Market	Both	Food	Income
Allium cepa	1			3.0	1.0
Arachis hypogea		1	1	0.5	3.0
Brassica spp	1	19	7	0.3	2.9
Cicer ariatinum	5	1	72	1.3	2.3
Citrullus lanatus	49			2.2	0.0
Cucumis sativus	50			2.2	0.0
Cuminum cyminum	1	3	7	1.3	2.7
Cyamopsis tetragonoloba	16	55	111	0.9	2.1
Gossypium hirsutum		8	1	0.9	2.6
Pennisetum glaucum	224	1	2	3.0	0.2
Plantago ovata		1		2.0	1.0
Praecitrullus	1			2.0	0.0
Ricinus communis		20	1	0.5	2.8
Sesamum indicum	16	6	2	1.7	0.7
Sorghum vulgare		8		0.0	2.5
Triticum aestivum	77		11	2.9	0.3
Vigna aconitifolia	90	3	45	2.2	0.6
Vigna radiata	83	6	31	2.3	0.6
Total	614	132	289		

Almost all perennial species were maintained exclusively for self-consumption. These species have multiple uses, and most species are used for mainly for food and to a lesser extent for fodder and fuel. A few were used for construction. The most widely used species was *Prosopis cineraria* followed by *Ziziphus nummularia* and *Acacia arabica*. These results suggest that multi-purpose perennial species make an important contribution to the livelihoods of households. Most of these species were maintained on farms, so agro-forestry innovations may be an entry point to improve the well-being of these households.

Table 5. Objective of production of perennial species and uses (number of households that stated the objective and a particular use for a species)

	Objective			Uses					
Species	Self	Market	Both	food	fodder	medicine	fuel	construction	other
Acacia arabica	78		1	60	7		12		
Acacia nilotica	41			3	15		22		
Areca catechu	17				13		3		
Azadirachta indica	49			4	12		3	3	2
Calotropis gigantia	72		1	4	24		43	2	
Clerodendrum multiflorum	26		1	1	3		22	2	
Cordia dichotoma	4		1	5					
Eucalyptus citriodora	2							1	1
Leptadenia pyrotechnica	20				1			19	
Mangifera indica	1				1				
Prosopis cineraria	222	1		210	13				
Salvadora oleiodes	42			24	16		2		
Senegalia catechu	52			49	1		1		
Tamarindus indica									
Tecomella undulata	64			1	31	1	27	4	
Ziziphus mauritiana	59			58			1		
Ziziphus nummularia	79			75	3			1	
Total	828	1	4	507	164	1	163	47	3

Diversity of domesticated animal species, objectives of production and uses

The number of domesticated animal species maintained by households is eight. The most common species are goats and cows, which are maintained in all villages and by substantial amount of households (Table 6). Buffalos and sheep are present in most villages, but are maintained by less than a fifth of households.

Table 6. Domesticated animal species maintained by households (number of households that maintained a species and number of villages where the species was present)

Species	Common name	No. households	No. villages
Bos dometicus	Cow	198	8
Bubalus bubalis	Buffalo	37	5
Camelus dromedarius	Camel	6	6
Capra hircus	Goat	216	8
Equus assinus	Donkey	3	2
Equus equus	Horse	1	1
Gallus gallus domesticus	Hen/cock	3	1
Ovis aeries	Sheep	42	7

Table 7 shows that all animal species were maintained for home-consumption and only goats and to a lesser extent sheep were maintained also for sale. Milk and dung are the most important products, with dung used both as fuel and fertilizer.

Table 7. Objective of production of the species and/or products derived from them and uses (number of households that stated the objective and a particular use for a species)

		Objective			Products and uses				
Species	Common name	Home-use	Sale	both	Milk	Dung fuel	Dung fertilizer	Hides	Others
Bos dometicus	Cow	185		12	200	188	195	0	0
Bubalus bubalis	Buffalo	30	1	5	35	32	36	0	1
Camelus dromedarius	Camel	5		1	2	1	5	0	0
Capra hircus	Goat	122	3	91	219	19	202	4	0
Equus assinus	Donkey	3			0	0	3	0	0
Equus equus	Horse	1			0	0	1	0	1
Gallus gallus domesticus	Hen/cock		1	2	0	0	0	1	3
Ovis aeries	Sheep	8	3	31	23	4	39	1	7

Table 8 shows that almost all households maintained only one breed of the species and almost all were local breeds. Very few households maintained improved breeds (the relative number of hen/cock refers to only 3 households).

Table 8. Breeds of species maintained by households (percentage of households)

		Household that maintained (%)		
Species	Common name	One breed	Local breeds	Improved breeds
Bos dometicus	Cow	98	96	3
Bubalus bubalis	Buffalo	100	100	14
Camelus dromedarius	Camel	100	83	0
Capra hircus	Goat	94	95	2
Equus assinus	Donkey	67	67	0
Equus equus	Horse	100	100	0
Gallus gallus domesticus	Hen/cock	100	33	67
Ovis aeries	Sheep	90	95	2

Seed Systems of domesticated plant species

A seed system is defined here as the interrelated set of actors, rules, interactions and infrastructure by which farmers obtain seed or planting material through time and space. Here we focus only on the situation during 2012 in the study villages. Table 9 shows that for annual domesticated species there was a balance between the seed/planting material saved by the household from its previous harvest and obtained from the outside, although clearly there are differences by species. For only very few species planted by very few farmers, the seed was exclusively either saved (onions, psyllium, and round gourd) or obtained from the outside (peanuts). For the seed/planting material obtained from the outside, surprising little was obtained from social networks (family, neighbours and friends). Local markets were the dominant source for most species except for chickpea and wheat, for which public and private seed traders were. Overall, public and private seed traders were an important source of seed for many species. Almost all sourcing of seed/planting material was done through purchases. Most seed/planting material for all species is replaced within three years,

though in a very few specific cases it is never replaced (Table 10). In terms of the number of varieties grown per species by households, most only grew one variety for most of the species. Table 11 shows that most of the varieties grown are local varieties (*desi*), although improved varieties were also common. Improved varieties were more usually grown only for mustard, chickpeas, castor and wheat. Almost all households indicated that they would want to get seed/planting material of other varieties for the species they grow, both improved and local varieties; though there seems to be a higher demand for improved varieties across all species.

In the case of perennial species though we asked the same questions households did not provide any information suggesting that the seed systems for this type of species are missing and households rely on what is in their farmers. Only a few households indicated that they got planting material. The status and dynamics of perennial species in these systems merit further research.

These results suggest that there is room for improving the functioning of seed systems. The facts that (1) most seed is sourced from markets, where information on seed characteristics, performance and seed quality is extremely variable and in many cases poor (Lipper et al. 2010); (2) households replace seed frequently; (3) are interested in acquiring additional varieties of both improved and local species; and (4) the diversity of varieties maintained by households is limited[2], suggest that there may be an important unfulfilled demand for seed/planting material of diverse varieties of multiple species. This in turn suggests the need to identify ways of improving the performance of the local seed systems. Given the demand for both improved and local varieties suggest the need for interventions in both the formal and informal seed sectors. In the case of the informal sector there is a need to explore options that improve the identification and supply of superior local varieties. These are areas that merit further research and action. In the case of perennial species, there is a need to have a deeper understanding of the way households are managing the reproduction of these species, and area that merits further research and action.

[2] In this study we were not able to explore in detail the diversity of varieties within species available at the village level for all species, i.e. households may plant on average one variety, but each household could planting a different one, so that diversity at the village level can be much larger than at the household level. This is an area that merits further work.

Table 9. Sources of seed/planting material of annual species (number of households that obtained seed/planting material for a particular species and from a particular source in 2012)

Species	Common name	Source of seed/planting material		If obtained outside, from whom						type of transaction
		Saved	Outside	family	neighbor	friend	public sector trader	private sector trader	local market	purchase (%)
Allium cepa	Onion	1								0
Arachis hypogea	Peanuts		2						2	100
Brassica spp	Mustard	2	25				4		21	100
Cicer ariatinum	Chickpea	10	68			2	24	16	26	100
Citrullus lanatus	Water melon	38	11	1	1			1	8	100
Cucumis sativus	Cucumber	37	13	1	1			1	10	100
Cuminum cyminum	Cumin	1	10					1	9	100
Cyamopsis tetragonoloba	Cluster bean	102	80	2	1		19	7	51	100
Gossypium hirsutum	Cotton	1	8					6	2	100
Pennisetum glaucum	Pearl millet	126	100	1	1	1	22	8	67	98
Plantago ovata	Psyllium	1								0
Praecitrullus	Round gourd	1								0
Ricinus communis	Castor	3	16	1				4	11	100
Sesamum indicum	Sesame	15	9	1				4	4	100
Sorghum vulgare	Sorghum	4	4					1	3	100
Triticum aestivum	Wheat	11	77			2	24	17	34	100
Vigna aconitifolia	Moth bean	91	46	1	1		7	8	27	93
Vigna radiata	Green gram	79	40	2	1		8	9	20	97
	Total	523	509	10	6	5	108	83	295	

Table 10. Frequency of seed/planting material replacement (number of households that replace seed planting material for a particular species at a particular frequency)

Species	Common name	Frequency of replacement			
		every year	every 2 years	every 3 years	never
Allium cepa	Onion			1	
Arachis hypogea	Peanuts	2			
Brassica spp	Mustard	25		2	
Cicer ariatinum	Chickpea	41	27	10	
Citrullus lanatus	Water melon	3	8	36	2
Cucumis sativus	Cucumber	5	6	37	2
Cuminum cyminum	Cumin	9	1	1	
Cyamopsis tetragonoloba	Cluster bean	63	54	60	4
Gossypium hirsutum	Cotton	7	1	1	
Pennisetum glaucum	Pearl millet	78	64	80	3
Plantago ovata	Psyllium			1	
Praecitrullus	Round gourd			1	
Ricinus communis	Castor	13	1	5	
Sesamum indicum	Sesame	10	5	9	
Sorghum vulgare	Sorghum	5		3	
Triticum aestivum	Wheat	50	27	11	
Vigna aconitifolia	Moth bean	31	49	55	2
Vigna radiata	Green gram	22	49	46	2
Total		364	292	359	15

Table 11. Number of varieties by species grown by households by type and demand of seed/planting material by households by type (number of households that grew a particular number of varieties overall and by type, as well as percentage that demanded seed/planted material)

		Number of varieties grown			Number of Desi varieties		Number of improved varieties		Demand for seed/planting material by type			
Species	Common name	1	2	3	1	2	1	3	% yes[1]	Desi	Improved	Both
Allium cepa	Onion	1			1		1		100		1	
Arachis hypogea	Peanuts	2					2		100		2	
Brassica spp	Mustard	27			8		20		100	1	23	3
Cicer ariatinum	Chickpea	77	1		35		54		100	3	54	21
Citrullus lanatus	Water melon	46	3		44		4		98	10	28	10
Cucumis sativus	Cucumber	47	3		43		6		98	11	28	10
Cuminum cyminum	Cumin	10	1		2		11		100	1	9	1
Cyamopsis tetragonoloba	Cluster bean	170	11	1	130	1	65	1	99	50	81	49
Gossypium hirsutum	Cotton	9			2	1	8		89	1	6	1
Pennisetum glaucum	Pearl millet	215	10	1	164	1	78		98	51	110	62
Plantago ovata	Psyllium	1			1		1		100		1	
Praecitrullus	Round gourd	1			1				100		1	
Ricinus communis	Castor	20			6				95	4	15	1
Sesamum indicum	Sesame	22	2		18	1	7		100	6	11	7
Sorghum vulgare	Sorghum	8			4		4		88	2	5	
Triticum aestivum	Wheat	87	1		34		63		100	3	65	20
Vigna aconitifolia	Moth bean	129	8		117		30		99	32	53	51
Vigna radiata	Green gram	113	6		104		24		98	26	50	42
Total		985	46	2	714	4	394	1		201	543	278

[1]Percentage of households who grew a species that would want to get seed/planting material of other varieties of the species

Gender and species diversity

For each species grown or managed by a household, we inquired on who took care of the species and who made decisions about: (a) the seed/planting material that was used; (b) field management; (c) consumption; and (d) marketing. The potential responses were: husband alone, wife alone, both, children. For annual species, Table 12 shows that by far the most common distribution of responsibility in terms of caring for a domesticated plant species involves both husband and wife, followed by wife alone indicating that in about a fifth of the households, the wife is in completely in charge of taken care of annual species.

Table 12. Distribution of responsibility for caring of annual domesticated plant species (number of households)

Who takes care of the species:	Husband alone	Wife alone	Both	Children	Total
Number of households:	7	50	166	6	229

In terms of decision-making, Table 13 shows the number of decisions made by household members related to the species they grew. There were 916 decisions (229 households and 4 decisions, there were missing data). Most decisions were made by both husband and wife (77%), followed by the husband alone (17%). While these results may suggest a degree of gender equity with respect to the management of species diversity, it is not clear exactly what the balance of power is when both spouses make decisions. This is an area of gender analysis that merits further research. An important issue of these results is to assess how these gender differences influence other outcomes at the household level.

Table 13. Number of decisions made by different household members about the annual species they grew

	Number of decisions				Total number of decisions[1]
Decision-maker	1	2	3	4	
Husband alone	79	21	6	4	155
Wife alone	10	6	1	3	37
Both together	7	26	77	104	706
Children alone	2	0	0	4	18

[1]This number results from multiplying the number in the cell by the corresponding number of decisions made in the column, and summing up across columns for each decision-maker (e.g. (79*1)+(21*2)+(6*3)+(4*4) for husband).

In the case of perennial species, Table 14 shows a relatively similar pattern as with annual plant species, the most common distribution of responsibility in terms of caring for a plant species involves both husband and wife, though the wife seems to be more involved in taken care of perennial species.

Table 14. Distribution of responsibility for caring of perennial plant species (number of households)

Who takes care of the species:	Husband alone	Wife alone	Both	Children	Total
Number of households:	21	43	161	4	229

Table 15 shows the number of decisions made by household members related to the species they grew. There were 916 decisions (229 households and 4 decisions, there were missing data). Most decisions were made by both husband and wife (75%), followed by the husband alone (19%).

Table 15. Number of decisions made by different household members about the perennial species they maintain

	Number of decisions				
	1	2	3	4	Total number of decisions[1]
Husband alone	56	35	6	7	172
Wife alone	12	4	2	3	38
Both together	12	39	53	110	689
Children	1	0	0	4	17

[1]This number results from multiplying the number in the cell by the corresponding number of decisions made in the column, and summing up across columns for each decision-maker (e.g. (56*1)+(35*2)+(6*3)+(7*4) for husband).

In the case of animal domesticated species, Table 16 shows that the most common distribution of responsibility in terms of caring for a plant species involves both husband and wife, though the wife seems to be more involved in taken care of animal species. In terms of decision-making,

Table 16. Distribution of responsibility for caring of annual domesticated animal species (number of households)

Who takes care of the species:	Husband alone	Wife alone	Both	Children	Total
Number of households:	8	61	166	3	238

Table 17 shows the number of decisions made by household members related to the species they grew. There were 940 decisions (235 households and 4 decisions, there were missing data). Most decisions were made by both husband and wife (76%), followed by the husband alone (14%).

Table 17. Number of decisions made by different household members about the animal species they maintain

	Number of decisions				
	1	2	3	4	Total number of decisions[1]
husband	31	39	9	14	93
wife	17	2	1	4	24
both	8	41	31	128	208
children	1			3	4

[1]This number results from multiplying the number in the cell by the corresponding number of decisions made in the column, and summing up across columns for each decision-maker (e.g. (31*1)+(39*2)+(9*3)+(14*4) for husband).

Risk, food security and species diversity

Respondents were asked to describe themselves in one of three categories depending on their risk attitudes (Table 18). Although this indicator of risk attitude is simple, it provides an idea of the

distribution of risk attitudes across the population. Interestingly, the most common attitude is that of a risk taker and the least common is the one of strong risk aversion.

Table 18. Respondents self-description of their risk attitude (number of respondents)

Risk attitudes	Number of respondents that describe themselves with that attitude	%
Take risks even if nobody else has done it	99	42
Take risks even if I have seen others taken before me	59	25
Never take risks, if I have seen others taken before me	78	33

Regarding food security, respondents were asked to state whether their household had experienced eight situations (events) regarding food insecurity in previous 30 days to the date of the interview and to rate how often they did. Table 19 shows that the majority of households experienced at least one of these events, besides being worried about not having enough food, the most common events have to do with a lack of choice due to lack of food or money. Table 20 shows the number of events experienced by households. Only about a quarter of households did not experience any food insecurity event, while the most commonly experienced at least one.

Table 19. Occurrence of food insecurity events and frequency by event (number of households)

Food insecurity condition	Affirmative responses	rarely	sometimes	often
During the last 30 days, have you been worried about the fact that your household could miss food?	173	145	27	1
During the last 30 days, has your household been unable to eat one or more foods usually consumed because of lack of food/money?	131	111	17	2
During these last 30 last days, has your household been forced to eat the same food because of lack of preferred food or money to buy other foods?	147	126	15	3
During these last 30 last days, has your household been forced to eat foods you usually avoid because of lack of preferred food or money?	104	88	12	3
During these last 30 last days, has your household been forced to reduce the quantity of food usually consumed because of lack of food/money?	37	33	2	1
During these last 30 last days, has your household lacked food because you did not have money to buy it?	27	24	2	2
During these last 30 last days, did any member of your family go to bed without eating?	4	2	2	0

During these last 30 last days, did any member of your family spend a whole day without eating because of lack of food?	4	3	1	0

Table 20. Number of households experiencing different levels of food insecurity

Number of food insecurity conditions experienced by households	Number of households
0	60
1	26
2	18
3	26
4	79
5	11
6	14
7	0
8	4

To explore how food insecurity may be related to species diversity grown by households and risk attitudes, we ran a Poisson regression on the counts of events of food insecurity experienced by a household (Table 21). The results are just preliminary and should be taken with caution since there may be additional covariates that we have not incorporated yet and additional diagnostic tests would have to be run. Bearing in mind these caveats, results suggest that households growing a higher number of species and with risk averse or cautious attitudes experienced lower levels of food insecurity. There are strong village effects, which will be expected since villages were chosen to represent different conditions. These results if they hold with additional variables, suggest that promoting a strategy of inter-specific diversification and risk minimization should contribute to make households more food secure. Together with the results from the seed system suggest that interventions that provide access to seed/planting material to households of different species with low risk could contribute to diversification and thus food security.

Table 21. Poisson regression of food insecurity, species diversity and risk attitude (dependent variable number of food insecurity events experienced in the past 30 days by the household)

Variable	Coefficient	
number of annual species grown on farm	-0.0632897	**
take risks if others have done (dummy)	-0.4463898	****
never take risks (dummy)	-0.4350999	****
Govindpura (dummy)	-0.2825547	*
Artiya (dummy)	-0.6998104	****
Dudhadia (dummy)	0.0011538	
Deda (dummy)	-0.0443603	
Damodara (dummy)	-0.7535671	****
Dedhu (dummy)	-0.4713654	***
Shakadiya (dummy)	-0.2931427	*

Constant	1.752713	****

Significance at the .10, .05, .01, .001 level indicated by *, **, ***, **** respectively
Number of obs = 228; LR chi2(10) = 79.76; Prob > chi2 = 0.0000; Log likelihood=-455.42925;
Pseudo R2 = 0.0805

Dietary diversity and sources of food

Figure 2 presents the number of food items consumed by mothers and children between 6 and 59 months of age in the study villages for a period of seven days previous to the day of the interview, as well as the transactions that mediated consumption (self-production, purchases, other). Market transactions accounted for 56% and 55% of all foods consumed for mothers and children respectively, while self-produced food accounted for 43% and 44% respectively; while other sources of food such as gifts, borrowed, food aid account only for 1%. If one takes into account that many of the food items purchased include foods that are not produced locally such as tea, sugar, cooking oil, etc., it is clear that production for self-consumption makes an important contribution to food consumed; there is no question however of the importance of the market for obtaining food. In terms of mean consumption of food items (Table 22), the same patterns are clear, with more purchased items that self-produced ones, however the latter still make an important contribution to diets for both mothers and children. Clearly both access to income and capacity to produced food for self-consumption are important factors for diets in these systems.

Figure 2. Number of food items consumed and transactions by which they were obtained by mothers and children

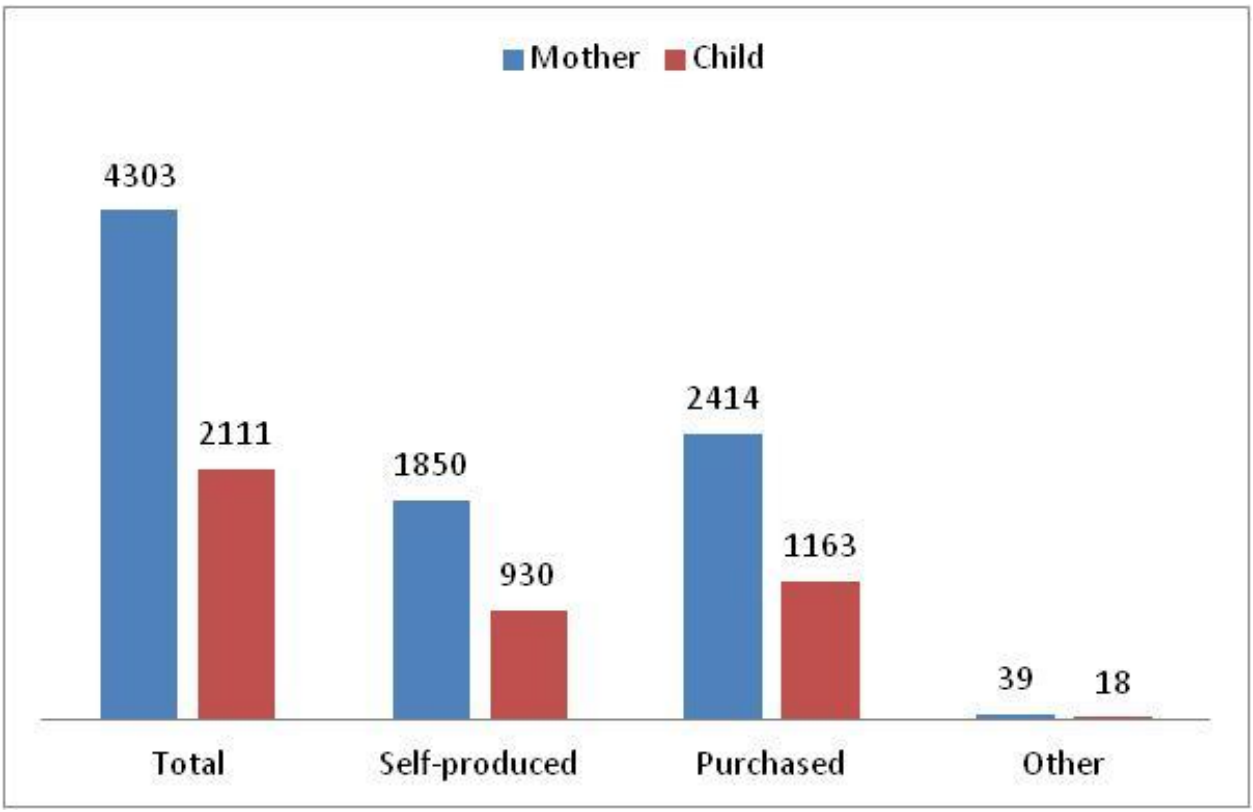


Table 22. Mean consumption of foods and transaction by mothers and children

	mean	st. dev.	max	min
Mother				
All food items consumed	18.5	3.5	33	6
Food items self-produced	7.9	2.6	24	1
Food items purchased	10.4	2.7	23	3
Child				
All food items consumed	16.0	7.1	33	3
Food items self-produced	7.0	3.6	24	1
Food items purchased	8.8	4.3	19	2

Socioeconomic factors

Table 23 shows that most of the households are male-headed, the head is middle aged with some level of formal education and households have about six members. Most land controlled by households is under cultivation and have multiple sources of income, though agriculturally-related ones are the most common. Table 24 shows that sale of agricultural products is the most common source of income, providing on average about a third of the income, followed by non-agricultural labor, also making a similar contribution. Other sources of income also relate to agriculture and make a more limited contribution to income. Clearly the household income is highly linked to agriculture, though is diversified and non-agricultural labor makes an important contribution.

Table 23. Key socioeconomic household characteristics

Indicator household	Variable
Sex of head (% male)	95.8
Age of head (years)	47.7
Education of head (years)	5.2
Family size (number)	6.3
Total landholding (mean in bigha[1])	
all	34.2
cultivated	28.8
uncultivated	5.5
Number of sources of income (mean)	4.3
Number of non agricultural sources of income (mean)	1.2

[1]Local unit of area

Table 24. Sources of household income

Sources of income	No. households	(mean % contribution)[1]
sale of agricultural products	225	32.3
sale of crop residues	12	7.7
sale of feed or forages	199	14.9
sale of livestock	104	14.4
sale of livestock products	27	11.5
agricultural labor	167	17.0
non-agricultural labor	207	32.1
regular employment	28	22.0
business self-employed	19	24.9
remittances	13	23.3
others	11	16.5

[1]Subjective evaluation by the head of the household

Training

As part of the implementation of the ABD-BS, two training courses were also organised for capacity building of partners for undertaking the baseline survey. Thirty three staff, including five female, who were involved in undertaking baseline survey were trained in undertaking Focal Group Discussion (FGD) before they were aksed to go to their respective site for HH survey. In addition to this 14 staff, including 4 female staff, were trained in the use of GPS and basic functions of GIS, using DIVA-GIS for mapping HH and other related information.

Conclusion

The results show that agricultural biodiversity, in terms of cultivated plant species, agroforestry trees and domesticated animal species plays an important role in the livelihood of these households. Agricultural production for self-consumption and for the market are important for these households and both are common objectives. In spite of this diversity, households face important problems of food insecurity, though our results suggest that agricultural biodiversity may play a crucial role in decreasing food insecurity, but further research is needed. Markets are an important source of food, income and seed. In the case of seed, local markets may not be the best source for it. Improving seed systems with a focus on providing diverse varieties of multiple species can be an entry point for improving these agricultural systems and improve household livelihoods.

References

Lipper, L., Anderson, C. L. and Dalton, T. J. (eds). 2010. *Seed Trade in Rural Markets Implications for Crop Diversity and Agricultural Development*. Earthscan: London, UK.