IMPORTANCE AND SEASONALITY OF VEGETABLE CONSUMPTION AND MARKETING IN BURKINA FASO[1]

OLE MERTZ, ANNE METTE LYKKE, AND ANETTE REENBERG

Mertz, Ole *(Institute of Geography, University of Copenhagen, Øster Voldgade 10, 1350 Copenhagen K, Denmark),* **Anne Mette Lykke** *(Department of Systematic Botany, University of Aarhus, Nordlandsvej 68, 8240 Risskov, Denmark), and* **Anette Reenberg** *(Institute of Geography, University of Copenhagen, Øster Voldgade 10, 1350 Copenhagen K, Denmark).*
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The use of vegetables in two rural communities in Burkina Faso is quantified through the use of food diaries kept by 13 households during one year. Interviews on preferences, field registration, and a market survey supplement the diaries. The use of wild species is concentrated on Parkia biglobosa, Corchorus *spp.,* Adansonia digitata, *and* Bombax costatum. *At least five other wild species are mentioned as important but very rarely occur in the diet, indicating the usefulness of diaries compared to interviews.* Capsicum frutescens, Abelmoschus esculentus, Allium cepa, *and* Solanum lycopersicon *are the most commonly used cultivated species. Wild vegetables constitute 35% and 59% of the total vegetable consumption in the two communities. Most products are highly seasonal in supply and prices vary accordingly. Households compensate for the seasonality by drying products, but stocks are often insufficient and vegetable purchases needed. Many of the vegetable species studied should be integrated in agricultural research and extension programs.*

Key Words: Burkina Faso; diet; ethnobotany; food diaries; quantitative methods; vegetables; wild food plants.

Consumption of vegetables from the wild or from home gardens is important for the nutrition of rural as well as urban populations in arid and semiarid areas of West Africa. Early studies (Dalziel 1937; Irvine 1948a, b) and later Burkill (1985–97) provide comprehensive descriptions of economic plants in West Africa, and numerous other studies have recorded specific uses and consumption patterns (Chastanet 1991; Gakou, Force, and McLaughlin 1994; Humphry et al. 1993; Lamien, Sidibe, and Bayala 1996). Chemical analyses also have been carried out, documenting the nutrient composition of important species such as *Adansonia digitata, Bombax costatum, Parkia biglobosa, Corchorus* spp., etc. (Glew et al. 1997; Nordeide et al. 1996; Smith et al. 1996), and Etkin and Ross (1982) have described the combined medicinal and dietary values of many wild and cultivated species in northern Nigeria. Consequently, there is good qualitative knowledge about which plants are used for which purposes and in some cases also on their nutritional value, but their frequency of occurrence in the diet and their seasonality rarely have been quantified.

The most common method for estimating the relative importance of various species is the combination of interviews with plant collection (Humphry et al. 1993; Smith et al. 1996; Wittig et al. 1992). However, Herzog et al. (1996) quantified the seasonality of consumption in Côte d'Ivoire by interviewing households once a month for a full year on their food intake over the past 24 hours. Nordeide et al. (1996) distributed their interviews in southern Burkina Faso between the rainy season (September) and the dry season (March), and Lamien, Sidibe, and Bayala (1996) carried out observations on selected products during an extended period between January and April in western Burkina Faso and also surveyed villages and district markets over a full year. These studies provide good estimates of consumption patterns and indicate which products are the most important, but the results could be difficult to extrapolate in time as many products are highly seasonal.

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In the present study we go one step further. Through daily registration of all food intake in two villages in Burkina Faso and weekly surveys of two district markets over a full year, we attempt to give a more precise picture of rural vegetable consumption, vegetable sales from local markets, and seasonal availability of products. We also look into the potential for taking some of the wild species into cultivation and the feasibility of increased focus of minor crop plants in extension and research. The paper focuses on vegetable ingredients in the "sauce" or relish that is traditionally consumed twice a day with a cereal staple, usually the thick porridge of millet or sorghum, known as *sagbo* in Moré. The sauce almost invariably contains vegetables and condiments, and sometimes fish, groundnuts, or other legumes. Meat is rarely consumed in the rural areas.

Study Area

The study took place in the Province of Boulgou in southeastern Burkina Faso. Two villages were selected to obtain data from a relatively enabled village, Silmiogou, and a less enabled village, Ningaré (Hansen and Reenberg 1998; Reenberg and Lund 1998). Enablement refers to household resources such as labor, animal traction, and access to land as well as market integration. Silmiogou is located at 0°28′ W and 11°53′ N at an altitude of 300 m, 18 km northwest of the provincial capital, Tenkodogo and 11 km from the second town of Garango. The village has a population of 570. Ningaré is located at 0°20′ W and 11°40′ N at an altitude of 280 m, 12 km south of Tenkodogo, and has a population of 860. The study site lies in the Sudanian agroecological zone with a precipitation of about 800 mm falling mainly from June to October. The natural vegetation is wooded savanna and woodland. The predominant ethnic groups are Bissa and Mossi and the majority of the population have farming as their main activity. The agricultural seasons during the period of study were characterized by farmers as poor (1997) and good (1998). Most households have one to three younger persons working abroad, often in Côte d'Ivoire. Literacy levels in the villages are generally low and only about 20% of the children attend school in the province (DANIDA/MAE 1997). In most households, however, there are at least one to two children who are able to read and write.

Methods

Eight households in Silmiogou kept food diaries from September 1997 to September 1998. The survey was extended with six households in Ningaré starting in mid-October 1997 and ending September 1998. Every evening the family gathered to write down ingredients of all food consumed for breakfast, lunch, dinner, and as snacks between the meals. They also indicated if the products were cultivated, collected in the wild, or bought. The 14 households could not be selected randomly as there needed to be at least two to three family members who could write in each household and the households were selected in collaboration with village responsibles. This may have biased the selection favoring households connected to the village leaders, but, based on the classification mentioned under study area, it was ensured that there were both more and less enabled households in the sample. Every week our local assistant collected diary pages of the past week and brought new pages for the coming week. More than 95% of the pages were completed and returned and the diaries consist of a total of more than 5000 pages. Diaries from one household in Ningaré were excluded from the analysis as there was a strong suspicion that a large number of sheets had not been filled in correctly (many weeks with exactly the same writing and ingredients). The food diary methodology is based on a similar study in Borneo (Christensen 1997).

The markets of Tenkodogo and Garango were surveyed for one year starting September 1997. Once a week, the number of market stands selling products originating from minor crops and wild plants were registered and prices were recorded by weighing samples of each product. This made it possible to determine seasonal variations in price and availability. The surveys were carried out mainly by the field assistant.

Various other interviews and registrations were carried out:

1. Two mixed groups (gender, ages) of 10–12 people participated in a scoring of specific characteristics of, and preferences for, different vegetable species using matrices drawn on the ground. Fresh specimens of each plant were placed in the matrix and evaluated on a scale from 1–5 with respect to taste, price, abundance, and tolerance to drought, poor soil, and insect attacks. Ten species of wild vegetables were

evaluated against each other as were 12 species of cultivated vegetables.

2. Selected wild herbaceous species were registered in 32 fields in Silmiogou located less than 10 minutes walk from the homesteads.

3. Semistructured interviews regarding the occurrence of useful woody plants and structured interviews regarding vegetable products dried for dry season consumption were carried out in all 14 households.

4. Wild plants were collected in the field with key informants (women) from three of the eight households in Silmiogou. Specimens were identified by comparison to herbarium vouchers located at AAU (Collections by Jens Madsen).

Field work took place on six occasions during which the participating households were visited and a full time field assistant was supervised (August–September 1997, October–November 1997, January 1998, March 1998, June 1998, and August–September 1998).

Results and Discussion

Frequency of Vegetable Use

The products of plant origin identified by the communities as ingredients in the sauce and those actually appearing in the food diaries are listed in Table 1. A total of 6534 meals were recorded in Silmiogou and 3211 in Ningaré. The two most frequently used products in the sauce, chili, *Capsicum frutescens,* and the fermented seeds of African locust bean, *Parkia biglobosa,* are not vegetables but rather sauce condiments or spices. Although two-thirds of the households in Silmiogou cultivate chili to a small extent (Mertz and Reenberg 1999), 87% of the chili occurring in meals is indicated as bought (99.7% for Ningaré). Three households in Silmiogou mostly use chili cultivated in their own gardens, but these households do not cultivate chili in larger quantities than others. Consequently, it appears that some households depend more on chili as a cash crop and therefore sell the entire harvest during a relatively short period of time. *P. biglobosa* is used to enhance taste, and in some areas it seems to have been replaced partially by purchased stock (Lamien, Sidibe, and Bayala 1996; Nordeide et al. 1996). In the present study both products are frequently used together, notably in Silmiogou where purchased stock occurred in 76% of all meals and in 70% of all meals it occurred in combination with *P. biglobosa* (representing about 77% of the meals with *P. biglobosa*). In Ningaré 21% of the meals contained stock and in 19% of the meals it occurred in combination with *P. biglobosa* (22% of all meals with *P. biglobosa*). It is unclear whether the high use of stock in Silmiogou is associated with a reduction in the use of *P. biglobosa.*

Corchorus spp. are the most popular wild vegetables. The leaves are harvested throughout the rainy season and dried for use in the dry season. In Silmiogou they occur in 19.4% of all meals and are second only to okra, *Abelmoschus esculentus.* In Ningaré, *Corchorus* spp. occur in 26.8% of all meals and are the most frequently consumed of all vegetables. The local name of *Corchorus* is *bulvaka* and five types are identified by the communities, representing three species, *C. olitorius, C. tridens,* and *C. trilocolaris.* The different local types were not specified in the food diaries, however, and all entries are listed under *C. olitorius* in Table 1. *C. olitorius* or jute is an important fiber crop in Asia (Palit 1999; Purseglove 1987), but in Burkina Faso it is mainly used as a vegetable. All three species are cultivated to a small extent around the major cities, but in the study area they occur as spontaneous plants in fields and gardens, where they are usually protected from weeding.

The leaves of the baobab tree, *Adansonia digitata,* is the second most important wild vegetable, but whereas in Silmiogou it is surpassed by several cultivated vegetables, in Ningaré it occurs in 23.5% of all meals and is second only to *Corchorus.* As with *Corchorus* spp., the leaves are eaten fresh in the rainy season and dried for consumption during the dry season. *Bombax costatum* is the third most important wild vegetable species and occurs in 8.7% of meals in Silmiogou and 12.3% in Ningaré. The tree flowers in February and the calyces are eaten fresh or dried. Leaves of the wild custard apple, *Annona senegalensis,* and a number of herbaceous plants such has *Ceratotheca sesamoides, Cleome gynandra, Celosia* spp., and *Cryptolepsis sanguinolenta* constitute the main part of the other wild vegetables consumed.

Cultivated vegetables are most important in Silmiogou. The fresh or dried fruit of okra, *Abelmoschus esculentus,* is the most widely consumed vegetable and is found in 22.5% of meals. Tomatoes, *Solanum lycopersicon,* and onions, *Allium cepa,* occur in 18.2% and 11.3% of

TABLE 1. SPECIES USED FOR "SAUCE" OR RELISH AND THEIR OCCURRENCE IN MEALS. TWELVE MOST COMMONLY USED SPECIES REPRESENTING THE TEN MOST FREQUENTLY USED SPECIES IN SIMIOGOU AND NINGARÉ ARE HIGHLIGHTED IN BOLD (THREE *CORCHORUS* SPP. COUNTED AS ONE). SOME WILD HERBACEOUS SPECIES IDENTIFIED AS FOOD PLANTS BUT NOT OCCURRING IN FOOD DIARIES ARE INCLUDED. SPECIES NAMES AFTER LEBRUN AND STORK (1991).

Species[1]	Family	Vernacular names English/*Moré*	Part used[2]	Origin[3]	Silmiogou		Ningaré	
					Occurs in no. of meals	% of total meals	Occurs in no of meals	% of total meals
***Abelmoschus esculentus* (L.) Moench**	Malvaceae	Okra/*Maana*	l	c	1472	22.5	532	16.6
***Adansonia digitata* L.**	**Bombacaceae**	**Baobab**/*Toeega*	l	s	598	9.2	756	23.5
Aframomum melegueta K. Schum.	Zingiberaceae	Grains of paradise/*Zûmbri*	fr	b	5	0.1	0	0
***Allium cepa* L.**	Alliaceae	Onion/*Zãyõ*	l	b	1186	18.2	434	13.5
Allium sativum L.	Alliaceae	Garlic/*Aye*	b	b	0	0	1	0
Amaranthus graecizans L.	Amaranthaceae	Spreading pigweed/*Silmig trabroko*	l	s	0	0	0	0
Amaranthus hybridus L.	Amaranthaceae	Slim amaranth/*Lisambo, Lisama*	l	b, s	7	0.1	0	0
Annona senegalensis Pers.	Annonaceae	Wild custard apple/*Barkudi*	l	s	166	2.5	43	1.3
***Arachis hypogaea* L.**	Fabaceae	Groundnut/*Nanguri*	se	c	1019	15.6	203	6.3
Bixa orellana L.	Bixaceae	Annatto/*Tomat-zom*	se	b	25	0.4	0	0
Boerhavia diffusa L.	Nyctagynaceae	Spreading hogweed/*Lengle*	l	s	0	0	0	0
Boerhavia sp.	Nyctagynaceae	*Kãtre wêgse*	l	s	0	0	0	0
***Bombax costatum* Pellegr. & Vuill.**	Bombacaceae	Kapok/*Vaaga*	fl	s	566	8.7	395	12.3
Borassus aethiopum Mart.	Arecaceae	African fan palm/*Zanya*	sp	b	78	1.2	0	0
Brassica sp.	Brassicaceae	Cabbage/*Su-põnpe*	l	b	121	1.9	7	0.2
***Capsicum frutescens* L.**	Solanaceae	Chili/*Kipare*	fr	b	6027	92.2	2892	90.1
Cassia obtusifolia L.	Caesalpiniaceae	Siclepod/*Sig-a*	l	s	3	0	1	0
Celosia argentea L.	Amaranthaceae	Quail grass/*Bougma*	l	s	0	0	0	0
Celosia trigyna L.	Amaranthaceae	*Zikoom*	l	s	0	0	0	0
Ceratotheca sesamoides Endl.	Pedaliaceae	False sesame/*Bundu*	l, se	s	17	0.3	0	0
***Citrullus colocynthis* (L.) Schrad.**	Cucurbitaceae	Colocynth/*Nato*	l	c	80	1.2	117	3.6
Cleome gynandra L.	Capparidaceae	Cat's whiskers/*Kelebdo*	le	s	19	0.3	1	0
Cleome viscosa L.	Capparidaceae	Tickweed/*Kinkinse kelebdo*	l	s	0	0	0	0
Combretum glutinosum Perr. ex DC.	Combretaceae	*Kuilinga*	l	b, s	0	0	4	0.1

TABLE 1. CONTINUED.

Species[1]	Family	Vernacular names English/*Moré*	Part used[2]	Origin[3]	Silmiogou		Ningaré	
					Occurs in no. of meals	% of total meals	Occurs in no of meals	% of total meals
Commelina sp.	Commelinaceae	Day flower/*Tak boanga*	l	s	0	0	0	0
***Corchorus olitorius* L.**	Tiliaceae	Tossa jute/*Bulvaka nafouti*	l	s (c)	1270	19.4	860	26.8
***Corchorus tridens* L.**	Tiliaceae	Jute/*Bulvaka basseg roo zaame, bulvaka pelga, Bulvaka raga*	l	s (c)	all *Corchorus* entries included under *C. olitorius*			
***Corchorus trilocolaris* L.**	Tiliaceae	Jute/*Bulvaka som saana*	l	s (c)	all *Corchorus* entries included under *C. olitorius*			
Cryptolepsis sanguinolenta (Lindl.) Schltr.	Asclepiadaceae	*Longlose*	l	s	6	0.1	0	0
Cucurbita pepo L.	Cucurbitaceae	Pumpkin/*Yogre*	fr	c	0	0	13	0.4
Cucurbita pepo L.	Cucurbitaceae	Pumpkin/*Yogre*	l/fr	c	19	0.3	0	0
Cucurbita pepo L.	Cucurbitaceae	Pumpkin/*Yogre*	l	c	0	0	8	0.2
Daucus carota L.	Umbelliferae	Carrot/*Karote*	t	b	3	0	0	0
Diospyros mespiliformis Hochst. ex A. DC.	Ebenaceae	Ebony/*Ganka*	l	s	0	0	5	0.2
Glycine max (L.) Merrill	Fabaceae	Soy bean/*Soza kolgo*	se	c	30	0.5	0	0
Gossypium spp.	Malvaceae	Cotton	se	c	7	0.1	0	0
Hibiscus cannabinus L.	Malvaceae	Kenaf/*Berga*	l	c	241	3.7	5	0.2
Hibiscus sabdariffa L.	Malvaceae	Roselle/*Bito, Wegda*	l	c	481	7.4	26	0.8
Hyptis spicigera Lam.	Lamiaceae	Black sesame/*Yulyungu daaga*	se, l	s	0	0	0	0
Ipomoea batatas (L.) Lam.	Convolvulaceae	Sweet potato/*Nayu*	l	b, c	1	0	35	1.1
Ipomoea eriocarpa R. Br.	Convolvulaceae	*Gilgito*	l	s	1	0	0	0
Lannea microcarpa Engl. & K. Krause	Anacardiaceae	*Sibga, sābtulga*	l	s	7	0.1	1	0
Leptadenia hastata (Pers.) Decne	Asclepiadaceae	*Lelengo*	l/fr	s	0	0	0	0
Moringa oleifera L.	Moringaceae	Horse-radish tree/*Arganna*	l	s	2	0	1	0
Ocimum basilicum L.	Lamiaceae	Basil/*Yulyungu*	l	s	0	0	0	0
***Parkia biglobosa* (Jacq.) R. Br. ex G. Don f.**	Mimosaceae	African locust bean/*Kolgo, dondo*	se	b	5095	78	2727	84.9
Piper nigrum L.	Piperaceae	Pepper/*Masuura*	se	b	339	5.2	1	0
Sclerocarya birrea (A. Rich.) Hochst.	Anacardiaceae	Maroola plum/*Nobga, sumwaka*	l	s	4	0.1	0	0
Sesamum indicum L.	Pedaliaceae	Sesame/*Siini*	se	c	1	0	0	0

TABLE 1. CONTINUED.

Species[1]	Family	Vernacular names English/*Moré*	Part used[2]	Origin[3]	Silmiogou		Ningaré	
					Occurs in no. of meals	% of total meals	Occurs in no of meals	% of total meals
Solanum aethiopicum L.	Solanaceae	Scarlet egg plant/*Kumba*	fr	c	19	0.3	0	0
Solanum aethiopicum L.	Solanaceae	Scarlet egg plant/*Kumba*	l	c	1	0	0	0
***Solanum lycopersicon* L.**	Solanaceae	Tomato/*Tomato*	fr	b	739	11.3	51	1.6
Solanum melongena L.	Solanaceae	Egg plant/*Bõda*	fr	c	18	0.3	0	0
Solanum nigrum L.	Solanaceae	Black nightshade/*Ludo*	l	b, c	17	0.3	0	0
Solanum tuberosum L.	Solanaceae	Potato/*Pom deteere*	t	b	27	0.4	0	0
Strychnos spinosa Lam.	Loganiaceae	Kaffir orange/*Kalyanga*		s	1	0	0	0
Stylochaeton hypogaeus Lepr.	Araceae	Barter's round arum/*Wuula*	fl	s	2	0	0	0
Tamarindus indica L.	Caesalpinaceae	Tamarind/*Pusa*	fr	s	5	0.1	0	0
Tribulus terrestris L.	Tribulaceae	Caltrop/*Segyala*	l	s	0	0	0	0
Vigna subterranea (L.) Verdc.	Fabaceae	Bambara groundnut/*Suma*	se	c	132	2	11	0.3
***Vigna unguiculata* (L.) Walp.**	Fabaceae	Cowpea/*Benga*	se	c	516	7.9	170	5.3
Vigna unguiculata (L.) Walp.	Fabaceae	Cowpea leaves/*Bengdo*	l	c	17	0.3	43	1.3
***Vitellaria paradoxa* C. F. Gaertn.**	Sapotaceae	Shea nut butter/*Taang-kaam*	fr	s, b	918	14	87	2.7
Vitex doniana Sweet	Verbenaceae	*Anto*	l	s	0	0	1	0
Zingiber officinale Roscoe	Zingiberaceae	Ginger/*Yamaku*	t	b	5	0.1	0	0
Ziziphus mauritiana Lam.	Rhamnaceae	Indian jujube/*Muglga*	fr	c	3	0	1	0
Unidentified		Spinach/*Epinaare*	l	b	1	0	0	0
Unidentified		*Bilgni*			1	0	0	0
Unidentified		*Boussonbula*		s	0	0	9	0.3
Unidentified		*Butou*		c	0	0	6	0.2
Unidentified		*Cinlbiola*		s	11	0.2	0	0
Unidentified		*Gãba-sinkaam*		b	20	0.3	0	0
Unidentified		*Kayido*		s	0	0	1	0
Unidentified		*Logonlo*		s	2	0	0	0
Unidentified		*Niyanyan*		s	1	0	0	0
Unidentified		*Silga*		s	1	0	0	0
Unidentified		*Rugi*		s	2	0	0	0
Unidentified		*Yoito*		s	0	0	11	0.3
Unspecified vegetables				b, c	44	0.7	0	0

[1] Voucher specimens collected by Jens Madsen and deposited at the herbaria in Aarhus (AAU), Dakar (DAKAR) and Ouagadougou.
[2] Parts used: bulbs (b), flowers (fl), fruits (fr), leaves (l), seeds (se), sprouts (sp), and tubers (t).
[3] Origin: primarily cultivated (c), spontaneous or semi-managed (s), or bought (b).

all meals, respectively. In Ningaré onions are also relatively important (13.5%) but tomatoes are rarely used. Tomatoes and onions are usually purchased, and the higher use in Silmiogou reflects the better economic situation in this village. Other important cultivated vegetables include *Hibiscus sabdariffa* and *H. cannabinus* which in Silmiogou supply leaves to 3–7% of all meals, but are rarely consumed in Ningaré. There, however, the leaves of the local water melon, *Citrullus colocynthis,* are relatively important. Finally, groundnuts, *Arachis hypogaea* and cowpea, *Vigna unguiculata,* are the most important legumes used in the sauce. Groundnut is used as a paste to thicken and flavor the sauce whereas cowpea seeds and leaves are occasionally added to the sauce. The seeds are often cooked separately.

Generally, there is a much broader choice of sauce vegetables in Silmiogou than in Ningaré. This may be partly explained by the higher number of households participating in the study, but the better economic situation in Silmiogou may also entice people to seek more variation in their diet by purchasing new products in the market. The variety could have important implications for the nutritional composition of the diet but this aspect was not examined by this study.

Relating Food Diaries and Interviews

Several of the wild herbaceous vegetables pointed out as potential sauce vegetables by the women in Silmiogou never appeared in the food diaries. They are, however, included in Table 1 for reference. The local preferences of wild species derived from interviews and a ranking of the species are presented in Table 2. It is obvious that a number of these species such as *Ipomoea eriocarpa, Boerhavia diffusa,* and *Tribulus terrestris* are famine foods that are not desirable if better alternatives are available. However, species such as *Celosia argentea, Amaranthus graecizans,* and *Ocimum basilicum* are ranked high for their taste but never appear in the food diaries. And the highest scoring species in the matrix, *Ceratotheca sesamoides,* appears only in very few meals.

There may be various reasons for this, depending on the species. *C. sesamoides* was mentioned by some farmers to be disappearing, but when asked which plants were left in the fields during weeding, it was not mentioned as one of them. Given that *C. sesamoides* is being domes-

Table 2. Ranking of herbaceous wild plants by a group of 6 women and 8 men in Silmiogou. Scores: 1 = very poor, 5 = very good.

Species	Taste	Sales price	*Score pref.*	Soil tolerance	Dought tolerance	Insect tolerance	*Score toler.*	Total score
Amaranthus graecizans	4	1	**5**	4	1	1	**6**	11
Boerhavia diffusa	1	1	**2**	1	1	1	**3**	5
Boerhavia spp.	1	1	**2**	1	1	1	**3**	5
Celosia argentea	5	5	**10**	1	1	1	**3**	13
Celosia trigyna	5	1	**6**	1	1	1	**3**	9
Cerathotheca sesamoides	5	4	**9**	5	5	5	**15**	24
Cleome gynandra	5	5	**10**	1	1	1	**3**	13
Cleome viscosa	3	1	**4**	5	1	1	**7**	11
Corchorus spp.	5	5	**10**	1	1	5	**7**	17
Cryptolepsis sanguinolenta	5	1	**6**	5	5	1	**11**	17
Ipomoea eriocarpa	1	1	**2**	4	1	1	**6**	8
Leptadenia hastata	4	1	**5**	5	5	5	**15**	20
Ocimum basilicum	5	5	**10**	5	5	1	**11**	21
Tribulus terrestris	1	1	**2**	1	1	1	**3**	5

High price = very good (when products are sold).

TABLE 3. COMPARISON OF SPONTANEOUS HERBACEOUS SPECIES WITH RESPECT TO OCCURRENCE IN A SAMPLE OF 32 FIELDS LOCATED LESS THAN 10 MINUTES WALK FROM THE SETTLEMENT, OCCURRENCE IN MEALS, AND TASTE PREFERENCE.

Species	Occurs in no. of fields	Occurs in no. of meals	Taste preference
Corchorus spp.	30	2130	5
Cleome gynandra	9	20	5
Ceratotheca sesamoides	7	17	5
Amaranthus hybridus	1	7	n/a
Cryptolepsis sanguinolenta	23	6	n/a
Leptadenia hastata	3	4	4
Ipomoea eriocarpa	31	1	1
Commelina spp.	29	0	n/a
Celosia trigyna	23	0	5
Boerhavia diffusa	19	0	1
Ocimum basilicum	5	0	5
Amaranthus graecizans	1	0	4

n/a: data not available.
Non-parametric correlation:
Occurrence in fields/occurrence in meals: Spearman's rho = 0.062, $P = 0.85$.
Occurrence in fields/taste preference: Spearman's rho = −0.055, $P = 0.89$.
Occurrence in meals/taste preference: Spearman's rho = −0.037, $P = 0.33$.

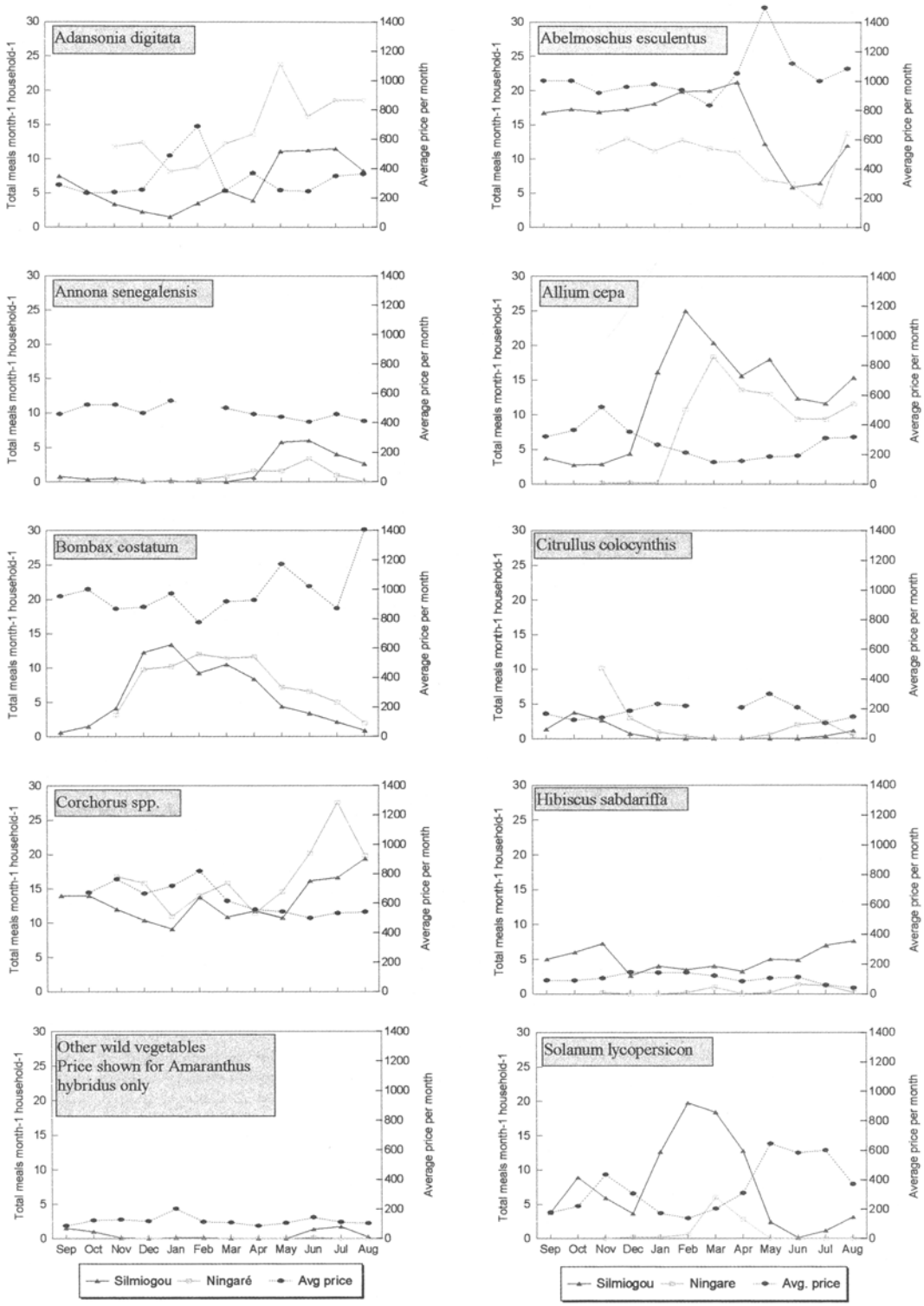
ticated in other parts of the Burkina and West Africa (Seignobos 1982; Smith, Clegg, Keen et al. 1996) and reaches the highest score of all wild species, further research on the lack of interest in its conservation in the present study area is needed. Species such as *Cleome gynandra, Celosia* spp., and *Cryptolepsis sanguinolenta* also occur in few meals despite being given high marks in the scoring.

To explain this contradiction, we used a non-parametric correlation of the frequency of use of spontaneous herbaceous species with taste preference and occurrence of species in a sample of 32 fields located close to the settlements. The data are shown in Table 3 but no distinct pattern of use is seen and the correlation proved non-significant.

To separate more appropriately the importance of the different species with respect to preference, a pair-wise ranking method where each species is weighted against each other may have been better. In other words, many wild species are considered good when evaluated alone, but if compared one by one with each other, a species that is regularly consumed, e.g., *Corchorus* spp. or *Hibiscus* spp., may get second priority and therefore belong to what may be termed a second hierarchy of tasty food plants that are only used if the main vegetables are not available. A third category would be the less palatable famine foods only consumed if nothing else is available.

Finally, there may also be other reasons for nonoccurrence of species in food diaries. Leaves of *Commelina* spp., for example, are used in millet cakes and may therefore not appear in the meals as the cakes are eaten as snacks, or if they are part of the meal, the different ingredients in the cakes may not be specified in the diaries.

Despite such possible reasons for the nonoccurrence of species in the diaries, this study demonstrates the value of diaries as a complement to interviews, which may not always be sufficient to analyze the importance of individual species. Most studies list the number of species available (Gakou, Force, and McLaughlin 1994; Humphry et al. 1993; Wittig and Martina 1995) and estimate their relative importance from plant collection and interviews alone. One study in Boulgou and Nahouri provinces of Burkina Faso estimated that the vegetable intake is divided between 36% wild plants and 64% cultivated plants (Smith et al. 1996). These figures are close to those of Silmiogou (35% and 65%) but far from those of Ningaré (59% and 41%) indicating that high local variability in plant use exists. The study by Smith et al. (1996) did not incorporate seasonal changes and, similarly, Lamien, Sidibe, and Bayala (1996) only provid-


Adansonia digitata
Abelmoschus esculentus
Annona senegalensis
Allium cepa
Bombax costatum
Citrullus colocynthis
Corchorus spp.
Hibiscus sabdariffa
Other wild vegetables
Price shown for Amaranthus hybridus only
Solanum lycopersicon
Total meals month-1 household-1
Average price per month
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
Silmiogou
Ningaré
Avg price
Ningare
Avg. price

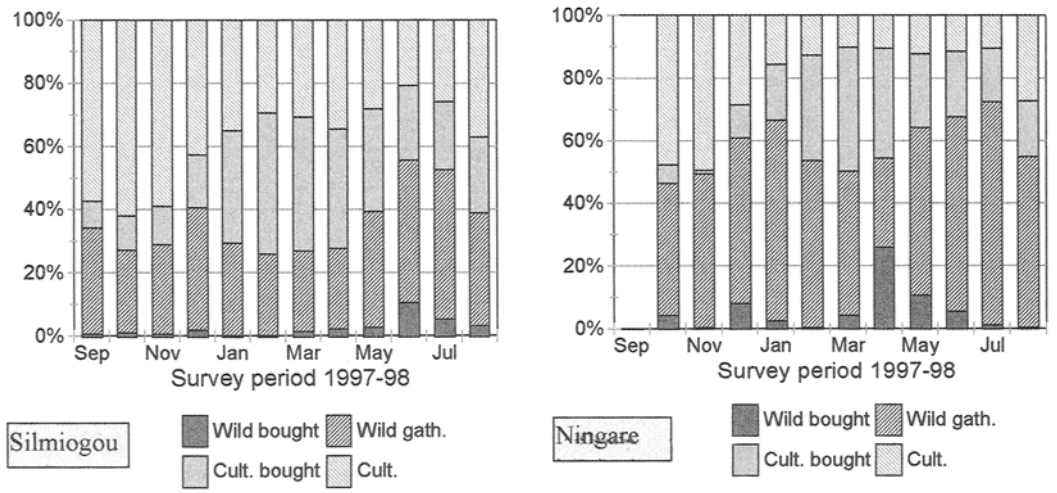


Fig. 2. Relative seasonal distribution of the consumption of wild, cultivated, and purchased plant ingredients occurring in the sauce in Ningaré and Silmiogou.

ed data from a three month period in the dry season and only for selected products.

Seasonal Distribution of Vegetable Availability and Marketing

The trends in seasonal distribution of some of the major vegetable species occurring in the diet as well as their price development shown as averages of prices in the markets of Garango and Tenkodogo are presented in Fig. 1.

Of the wild species, *Corchorus* spp. are used throughout the year as all households dry the leaves. The peak season is clearly in May–June, the early part of the rainy season, when the desirable fresh new leaves are most abundant and cultivated vegetables are in short supply. *Adansonia digitata* and *Annona senegalensis* follow the same pattern as *Corchorus* spp. *Bombax costatum* is more seasonal as it flowers in the dry season and conservation of dried plant material into the rainy season is rarely practiced because of the abundance of other products during that time. Other wild vegetables include *Amaranthus hybridus, Ceratotheca sesamoides, Cleome gynandra, Cryptolepsis sanguinolenta,* and *Ipomoea eriocarpa.* They only occur in a total of 55 meals in the two villages. Their consumption is concentrated in the rainy season.

Consumption of the cultivated species *Abelmoschus esculentus* and *Hibiscus sabdariffa* is distributed throughout the year as the fruits and leaves are dried. The sharp decline in consumption of *A. esculentus* from April to June in Silmiogou indicates that stocks have run dry, and in this period wild substitutes are particularly important. *H. sabdariffa* is less variable as the leaves of young plants can be consumed early in the rainy season. The reason for the low consumption of this species, generally considered popular, in Ningaré is not known but may be due to a poor harvest in 1997. Onions and tomatoes are grown to a small extent in the rainy season in Silmiogou. However, both species are mainly consumed in the dry season, which is the peak period for irrigated vegetables, and as only two households in Silmiogou have dry season gardening (Mertz and Reenberg 1999), most tomatoes and onions are bought.

Some differences between the villages can be deduced from Fig. 1. Ningaré relies to a larger

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Fig. 1. Trends in seasonal distribution of important vegetable species in the sauce of households in Silmiogou and Ningaré compared to average prices at the markets of Garango and Tenkodogo. Prices are in FCFA per kg (100 FCFA = 1 FRF) for dried products except *Allium cepa, Hibiscus sabdariffa, Solanum lycopersicon* and *Amaranthus hybridus* which are sold fresh. Standard error on price is generally in the range of 40–80 FCFA, but reaches 100 FCFA in a few instances.

TABLE 4. HOUSEHOLD AVAILABILITY OF DRIED VEGETABLE PRODUCTS IN APRIL 1998.

Species	Products dried in rainy season 1997. no. of households			Products still in stock April 1998. no. of households		
Wild species	Nin	Sil	Total	Nin	Sil	Total
Adansonia digitata	6	8	14	4	7	11
Annona senegalensis	0	5	5	0	3	3
Bombax costatum	6	8	14	3	7	10
Ceratotheca sesamoides	0	1	1	0	0	0
Corchorus spp.	6	8	14	3	7	10
Cultivated species						
Abelmoschus esculentus	6	7	13	3	6	9
Hibiscus cannabinus	4	8	12	1	7	8
Hibiscus sabdariffa	4	8	12	2	7	9
Vigna unguiculata	0	1	1	0	1	1

Nin = Ningaré.
Sil = Silmiogou.

extent on wild vegetables, notably *Adansonia digitata* which is consumed in higher amounts than in Silmiogou. The use of "luxury" products such as tomato is also much more limited in Ningaré. This tendency can be seen even more clearly in Fig. 2, where the relative seasonal distribution of wild, cultivated, and purchased species is presented. Ningaré relies more heavily on gathered species, notably in the end of the dry season and the beginning of the rainy season, and during this period a larger number of wild as well as cultivated products are also bought. Wild species constitute more than 60% of vegetable intake in Ningaré during the months of December–January and May–July, whereas the figures for Silmiogou are somewhat lower.

When comparing these data with the price development and availability of vegetables at the markets of Garango and Tenkodogo (Fig. 1), it appears that the peak period for purchasing vegetables in March–April coincides with a period of relatively low prices on cultivated vegetable products. This coincidence is probably caused by diminishing household stocks of dried vegetables (see Table 4) and the reappearance of fresh products in the market. Similarly, the price peaks of *Corchorus* spp. and *Adansonia digitata* by the end of February can only be interpreted as a result of diminishing stocks of dried vegetables for marketing. *Bombax costatum* prices predictably increase during the rainy season when stocks become low and urban demand is likely to remain high. *Annona senegalensis* is sold at stable prices throughout the year but in small quantities and of the herbaceous wild vegetables, only *Amaranthus hybridus, Cleome gynandra* and *Celosia argentea* appear occasionally in the market. They are usually sold fresh. Lamien, Sidibe, and Bayala (1996) reported smaller price fluctuations of *A. digitata* and *B. costatum* in western Burkina Faso, but price peaks are seen in roughly the same periods.

The large variation in tomato prices is caused by the intensive irrigated dry season cultivation that stops abruptly in May as farmers start preparing their subsistence fields and the increased humidity causes disease problems in tomatoes. The December price peak illustrates that rainy season crops have been sold and dry season crops are not yet ready. Onion follows a similar pattern although the better conservation of onion bulbs keeps prices down after the dry season. Prices of dried fruits of *Abelmoschus esculentus* predictably increase at the beginning of the rainy season when dried stocks run out and fresh supplies are still unavailable. *Hibiscus sabdariffa* is mostly sold fresh and the leaves are relatively easily produced all year round with irrigation, hence the stable and comparatively low prices.

Both communities rely on dried products in the dry season as *B. costatum* is the only fresh product available other than irrigated vegetables. Table 4 shows the vegetables dried in 1997 by the participating households and the stock left by April 1998. Eight of the 14 households claimed to have sufficient stock to last until fresh products would be available in May–June

1998, two mentioned having some stock but not enough, and three were already out of stock and forced to buy vegetables in the market. The households in Silmiogou were better stocked with products in April than those in Ningaré, and this supports the data in Fig. 2 showing that Ningaré relies more heavily on purchased vegetable products in April than Silmiogou. The amount of dried vegetable products is therefore a crucial parameter in the household economy as sufficient stocks render them independent of the strong seasonality of many products and the associated price fluctuations.

The data in Table 4 reiterate the importance of *A. digitata, B. costatum, Corchorus* spp., *A. esculentus* and *H. sabdariffa* in the household vegetable supplies. *H. cannabinus* leaves are also frequently dried although the food diaries showed a relatively low consumption.

Extension and Research—Concluding Remarks

Based on the consumption patterns in the two communities, this paper establishes that wild and cultivated vegetables are very important for the livelihood of local communities whether they are part of the subsistence economy or traded in the market. However, it also appears that the range of popular products is quite narrow. Many vegetable species are recognized as valuable and tasty but almost never consumed and the main preferences are limited to four wild species and six cultivated species.

The use of leaves from the tree species *Adansonia digitata, Bombax costatum,* and *Annona senegalensis* is important and two other tree species, *Parkia biglobosa* and *Vitellaria paradoxa* provide some of the most frequently used non-vegetable products. Conservation and management of these species should therefore be actively encouraged in extension programs, notably because there is some evidence regarding a declining population of these and other important tree species in the traditional farming systems of Burkina Faso (Guinko 1984). In Silmiogou and Ningaré, 23 of 28 respondents mentioned that *Vitellaria paradoxa* was disappearing and 20 mentioned *Bombax costatum.* More data on tree populations and their regeneration in fields are needed, however.

The only wild herbaceous plants used extensively are *Corchorus* spp. Their cultivation is already well known elsewhere and could be actively promoted as garden crops as they seem to grow easily in fields and gardens without maintenance. Most of the other wild herbaceous vegetable species are rarely consumed but they may be important as famine foods in years with very low or irregular rainfall. These species are not considered to have a substantial potential for domestication at present, although marketing does occur and could be developed further in the future. The spontaneous domestication of e.g., *Ceratotheca sesamoides* described in other parts of the region (Seignobos 1982; Smith, Clegg, Keen et al. 1996) is not likely to take place in the communities studied.

The cultivated species, *Hibiscus* spp. and *Abelmoschus esculentus,* are already traditionally integrated in the farming systems of Silmiogou and Ningaré. However, research in the Sahel on these species is limited as the focus has been on cereal crops alone or in combination with legumes (Ndunguru and Williams 1993; Ntare and Williams 1992). Moreover, extension services in Boulgou Province or Burkina Faso do not incorporate vegetables in their programs to any significant extent. Extension work could, however, draw on the results of studies in other West African countries which demonstrate the value of intercropping between cereal crops and vegetables, even if these studies are mostly conducted in the sub-humid or humid zones (Ikeorgu, Ezumah, and Wahua 1989; Muoneke and Asiegbu 1997; Olasantan 1992).

Generally, it is essential that nutritionists and botanists communicate with agricultural researchers and extension services in order for all aspects of the food production systems to be considered. The study by Traoré and Maillet (1992) on weeds in Burkina Faso is a classical example in which several of the useful species discussed in this paper are mentioned as noxious weeds (e.g., *Corchorus* spp., *Ipomoea eriocarpa,* and *Hyptis spicigera*). The paper does not recognize the utility of these species and fails to acknowledge that clean weeding may not always be desirable. The agronomic studies on the compatibility of field crops and tree species, notably shea nut, *Vitellaria paradoxa* and *P. biglobosa,* are a step in this direction (Kessler 1992; Wilson, Brook, and Tomlinsom 1998) although herbaceous vegetable species are rarely part of these studies.

The methodology developed in this paper could easily be replicated in other regions and

over longer time spans in order to provide adequate data on human food preferences and the importance of different plant products. If quantitative consumption patterns are obtained in this manner, interpretation of "soft" data from interviews on plant uses is likely to be improved. Replication in several communities is necessary, however, as this study has illustrated marked difference in plant use between just two villages. Rigorous follow-up on households participating in such a study is also needed to maintain consistency in data quality.

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