Reports

Out of Africa: The Initial Impact of Millets in South Asia[1]

STEVEN A. WEBER
Washington State University, Vancouver, Wash. 98686, U.S.A. 1 X 97

The early plant-based food economy of the inhabitants of South Asia is thought to have been greatly influenced by a group of millets from Africa. Until recently, the study of millets has concentrated on areas of western India such as Gujarat, where they are known to have been in use and where it has been proposed that they had a critical impact (Possehl 1986, Weber 1992). Little was known about the occurrence of millets elsewhere, and it was assumed that they were of less importance outside of the southernmost areas of Harappan or Indus civilization at least until the 2d millennium B.C. New evidence requires us to revise our ideas about when African millets first appeared in South Asian agricultural systems and their role in the Harappan civilization. The earliest finds of millets in South Asia, dating to the 3d millennium B.C., are of a local variety. Thus, the picture for Gujarat, where the African millets were integrated into well-developed subsistence systems already containing other millets, also holds true in the heartland of the Harappan civilization.

MILLETS AND THE ARCHAEOLOGICAL RECORD

"Millet" is a generic term for unrelated forage grasses known for their coarse grains. While some confusion exists over which plants should be considered millets (Weber 1990), the term is well established, appears regularly in the literature, and cannot be avoided in any discussion of South Asian subsistence. Eight millets are commonly represented in the archaeological record of South Asia and continue in use today (table 1). While sorghum is called the "great millet" in South Asia (Nayar 1985), in many regions of the world it is not considered a millet. Though to some extent the origin of these millets is still debated, there is some consensus as to where these plants were first cultivated (see Doggett 1989, Harlan 1992). *Sorghum, Eleusine,* and *Pennisetum* are believed to be of African origin (Doggett 1970; Harlan 1976, 1989; De Wet and Harlan 1972). *Setaria, Enchinochloa,* and *Panicum miliaceum* are likely of East Asian origin. Of South Asian origin are *Paspalum scrobiculatum* and *Panicum sumatrense* (Hutchinson 1976, Weber 1990).

All eight of these millets are, and probably were, grown for both their grain and their straw as a cattle fodder (Seetharam, Riley, and Harinarayana 1989). They are annual warm-weather grasses that grow in semiarid zones in soils of low fertility and in regions of moderate rainfall. Today in South Asia these plants are generally rain-fed crops growing in dry-land farming conditions. Millets are sown in summer and watered by monsoon rains. They require no more than 30–40 cm of rain in order to mature. After three or four months they are ready for harvesting. Since they produce some seeds even in years with minimal rainfall and grow well in a variety of soils with little human management, they are considered drought-resistant.

It is worth noting that *Chenopodium album,* which occurs frequently in the archaeological record where millets occur, has many of the same characteristics. *C. album,* like the millets, was probably valued for its hardiness, its ability to grow in areas with short growing seasons and deficient soils, and its large, compacted heads, with many small seeds that were easy to collect and process. At Rojdi, when millets decline in numbers *Chenopodium* increases in importance, suggesting that it was a substitute for millets (Weber 1991). This pattern may represent cultural choice based on perception of common features that are not accounted for in standard taxonomic classification. In other words, the category "millet" may have to be expanded to accommodate the range of plants that prehistoric South Asians viewed and used in similar ways.

The archaeological record for millets in South Asia is limited because palaeoethnobotany and archaeobotanical analysis are relatively new to the region. Though the number of sites with charred plant parts exceeds 100, fewer than 10 have been systematically analyzed for archaeobotanical remains. Because of this, emphasis has been placed on first occurrence or simple presence of species in the archaeological record, without the information about context, provenience, condition, or numbers that can illustrate their economic and cultural importance. Where either water flotation or dry screening methods have been applied, large numbers and varieties of plant parts have been recovered.

At the sites of Rojdi in India and Harappa in Pakistan, soil samples from a variety of locations and features were collected and analyzed to ensure an accurate reconstruction of plant occurrence and usage (see figs. 1 and 2). Thousands of liters of soil were systematically collected and floated from hearths, floors, streets, walls, pits, storage areas, drains, trash, general fill, and even

TABLE 1
Early South Asian Millets and Their Origins

Millet	Common Names	Country of Origin	Earliest Finds in South Asia
Setaria italica	Foxtail millet	East Asia	2400 B.C.
Panicum miliaceum	Broomcorn or common millet	East Asia	1900 B.C.
Enchinochloa colona	*Sawa* or barnyard millet	East Asia	1900 B.C.
Panicum sumatrense	Little millet	South Asia	3000 B.C.
Paspalum scrobiculatum	*Kodo* millet	South Asia	1700 B.C.
Eleusine coracana	*Ragi* or finger millet	Africa	2500 B.C.
Sorghum bicolor	*Jowar* or large millet	Africa	2000 B.C.
Pennisetum typhoides	*Bajara* or pearl millet, bullrush millet, spiked millet	Africa	1900 B.C.

FIG. 1. *South Asian sites with recovered millets from the 3d and 2d millennia B.C.*

inside pots (Weber 1991, 1992). The result is a database with tens of thousands of carbonized seeds representing dozens of species. Detailed analysis of the full range of material found in each sample (i.e., charcoal, weed seeds, chaff, and glumes) has allowed conclusions regarding the economic and cultural importance of the identified plant material. As a result of these analyses, crop-processing areas are better understood, plants used for fuels are identifiable, agricultural systems are reconstructable, and the issue of millets can be readdressed.

Carbonized seeds of millets have been recovered from 25 sites from before or during the 2d millennium B.C. (table 2). Many of these seeds were recovered in high densities from the floors of living areas (over 1,000 seeds per liter of soil), making up nearly 100% of a given sample. In some cases, millets were also recovered from storage areas where the seeds were cleaned so that no chaff or glumes were present. Instances like these clearly suggest that millets were contributing directly to the diet of the inhabitants of these sites and that their occurrence is not the result of some other activity such as the burning of seed-laden dung for fuel.

Although these 25 sites are distributed throughout India and Pakistan, all of the oldest finds of millets, including those from Africa, are located in the northwestern region of South Asia and are directly or indirectly associated with the Harappan civilization. For this reason the following discussion will be framed in terms of the three phases of the Harappan cultural tradition: the Early Harappan period (4000 to 2550 B.C.), the Harappan period (2550 to 2000 B.C.), and the Late Harappan period (2000 to 1700 B.C.). It should be noted that there were many 3d- and 2d-millennium societies that were beyond the influence of Harappan culture. Until the archaeobotanical record from these other areas becomes clearer, it is unknown if the agricultural strategies of northwestern South Asia were similar to those in other parts of South Asia.

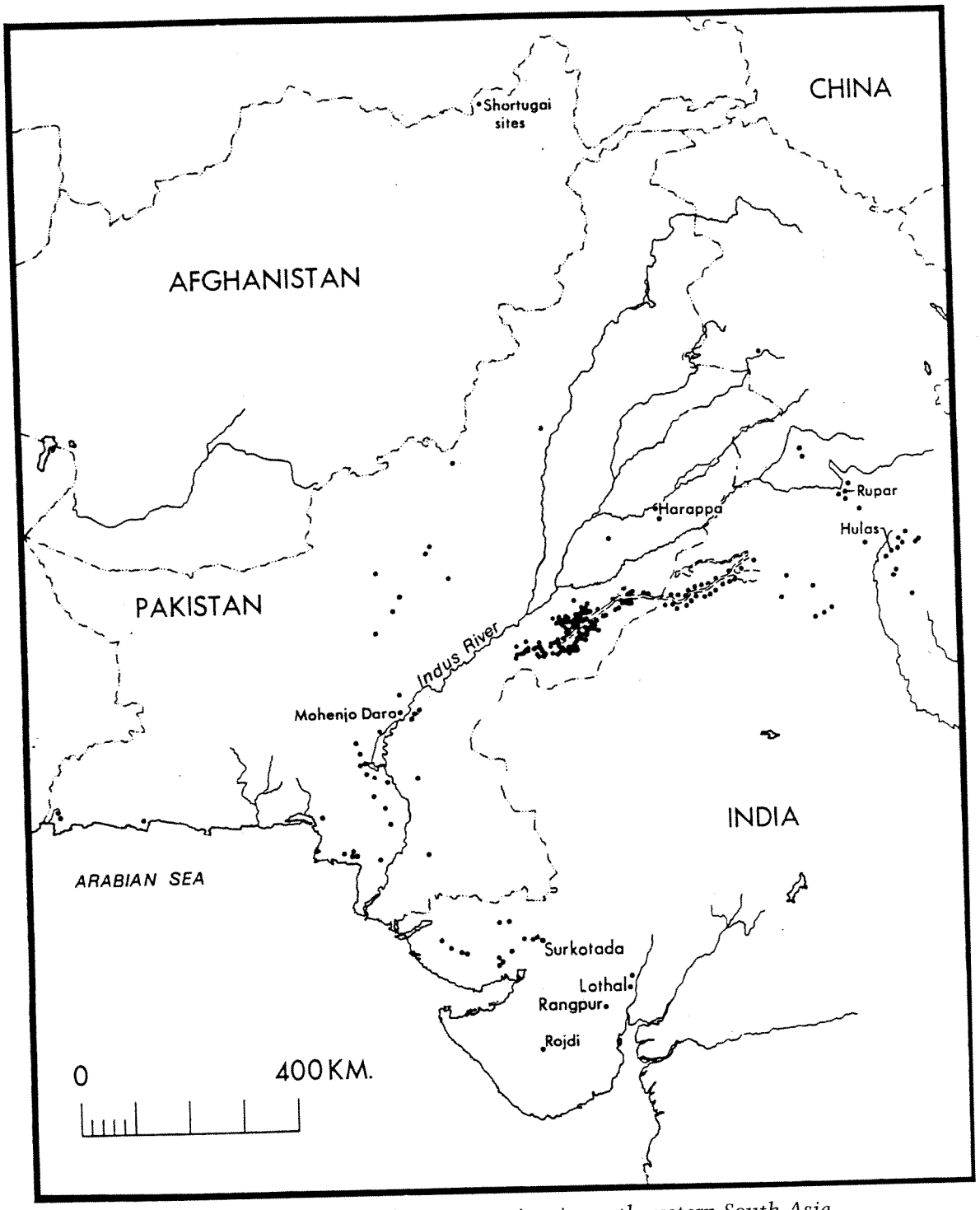

FIG. 2. *Distribution of Harappan sites in northwestern South Asia.*

AFRICAN MILLETS AND THEIR ROLE IN SOUTH ASIAN AGRICULTURE

Broadly speaking, South Asia had two basic agricultural strategies. One strategy, relying on winter rains, involved crops sown in the fall and harvested in the spring (*rabi*). This agricultural system included barley, wheat, oats, peas, lentils, chickpeas, jujube, mustard, and grass peas and was initially found in northwestern South Asia (Baluchistan, Sind, Punjab, Swat, and Kashmir) and limited parts of northwestern and western India (Kutch and Maharashtra), north-central India (Uttar Pradesh and Haryana), and central India (Madhya Pradesh). The second strategy, making use of summer monsoon rains,

TABLE 2
South Asian Sites Dating to the 3d and 2d Millennia B.C. with Millets

Region and Site	*Sorghum*	*Eleusine*	*Pennisetum*	*Setaria*	*Paspalum*	*Panicum*	*Enchinochloa*	Date B.C.
Punjab								
Harappa	—	H/LH	—	H/LH	—	EH/H/LH	—	2600–1900
Rohira	?H	—	—	—	—	—	—	2500–1800
Rupar	—	—	—	—	x	—	—	2000
Baluchistan								
Pirak	LH	—	—	—	—	LH	—	2100–1500
Kutch								
Surkotada	—	x	—	x	—	x	x	2300–1800
Kashmir								
Gufkral	—	?	—	—	—	—	—	2300
Haryana								
Banwali	—	—	—	x	—	—	—	200
Rajasthan								
Ahar	x	—	x	—	?	—	—	1750–1300
Afghanistan								
Shortughai	—	x	—	—	—	x	—	2300–1800
Gujarat								
Rojdi	LH	H/LH	—	H/LH	?LH	H/LH	?LH	2500–1800
Lothal	—	—	LH	LH	—	—	—	1900–1500
Oriyo Timbo	—	x	x	x	—	x	—	2000–1500
Rangpur	—	—	x	—	—	—	—	2000–1000
Vaghad	—	—	—	—	—	x	x	2000?
Uttar Pradesh								
Hulas	—	x	—	—	—	—	—	2100
Maharashtra								
Daimabad	x	x	—	x	x	—	—	1900–1000
Inamgaon	x	x	—	x	—	x	—	1600–700
Kaothe	—	—	x	x	—	—	—	1700
Kaustan	x	—	—	—	—	—	—	1500–1000
Nevasa	x	x	x	—	x	—	—	1800–1500
Sonegaon	—	x	—	—	—	—	—	1200
Tuljapur Gorhi	x	—	—	—	—	—	—	1000
Karnataka								
Tekkalakota	—	x	—	—	—	—	—	1800–1500
Hallur	—	x	x	—	x	—	—	1800–1500
Tamilnadu								
Paiyampalli	—	x	—	—	—	—	—	1400

NOTE: x = present; H = present and associated with the Harappan period; EH = present and associated with the Early Harappan period; LH = present and associated with the Late Harappan period.

centered on plants sown in the summer and harvested in the fall (*kharif*). Prehistorically, the summer-sown plants included millets, rice, cotton, dates, and the Indian summer pulses (gram). These were found most often in Gujarat and western India (Saurashtra, Kutch, Rajasthan, Maharashtra), north-central India (Uttar Pradesh), South India (Karnataka and Tamil Nadu), and pockets of central India and northwestern South Asia. *Rabi* crops of wheat and barley appear as early as the 7th millennium B.C.; *kharif* crops such as millets appear much later, beginning in the 3d millennium B.C. The Harappan civilization was founded upon wheat and barley cultivation (Thomas 1983, Costantini 1990, Meadow 1989). Summer millets have conventionally been regarded as having had a dramatic impact on people in the region, stimulating settlement in new areas of the subcontinent that were less hospitable for wheat and barley and thus contributing to the deurbanization of the Indus Valley (Possehl 1986; Jarrige 1985; Meadow 1989, 1991, 1996). However, alternative interpretations of the data are possible, and the latest evidence seems to cast doubt upon the traditional view.

Regional traditions with distinct artifact styles arose out of the Neolithic and lasted from ca. 4000 B.C. to ca. 2500 B.C. During this Early Harappan period, many of the features that have become associated with the Harappan tradition first appeared. Settlements typically show enclosing walls, community planning, standardized brick size, metallurgy, and some indication of long-distance trade (Kenoyer 1991). These communities intensively farmed nearby areas to satisfy local consumption needs (Weber 1996). The regionwide agricultural

TABLE 3
Cultivated Plants from South Asian Sites of the 3d and 2d Millennia B.C.

Plant Taxon	Cropping Season	Region and Date B.C.		
		4000–2600	2550–2000	2000–1700
Cereals				
Wheat (*Triticum*)	W	R	R	R/K
Barley (*Hordeum*)	W	R	R/K	R/K
Rice (*Oryza*)	S	—	K	R/K
Millets	S	K	R/K	R/K
Pulses and vegetables				
Peas	W	R	R/K	R/K
Pisum	W	—	R	R/K
Cicer	W	R	R/K	R/K
Lathyrus	W	R	R/K	R/K
Lentils (*Lens*)				
Gram	S	—	K	R/K
Dolichos	S	—	K	R/K
Phaseolus	S	—	R/K	R/K
Vigna	S	—	K	R/K
Medicago				
Oilseed and fiber	W	—	R/K	R/K
Linseed (*Linum*)	W	—	R/K	R/K
Mustard (*Brassica*)	S	—	R/K	R/K
Sesame (*Sesamum*)	S	R(?)	R	R/K
Cotton (*Gossypium*)				
Fruits	S	—	K	R/K
Melon (*Cucumis*)	S	R	R	R
Date (*Phoenix*)	W	R/K	R/K	R/K
Jujube (*Ziziphus*)	S	R	R	R/K
Grape (*Vitis*)				

NOTE: W = winter/spring-harvested; S = summer/fall-harvested; R = *rabi* areas, with winter rain; K = *kharif* areas, with summer rain.

pattern during this period exhibits extensive variation from one area to the next. Communities focused on either *rabi* or *kharif* systems depending on which was better suited to their environment, though Indus Valley sites displayed the *rabi* pattern and a few sites yield evidence of both summer and winter crops. Harappa depended upon the winter cultivation of wheat and barley, but recent finds of carbonized grains of little millet (*P. sumatrense*) on room floors and in a cleaned state, without glumes or chaff, show that summer millets were being used there by the 4th millennium B.C.

A fusion of a number of different cultural groups led to the formation about 2500 B.C. of the Harappan civilization. During this period, with a high degree of sociopolitical integration, we encounter fully developed city complexes with large populations, public architecture, a uniform standard of weights and measures, and a form of writing (Jacobson 1986, Kenoyer 1991). While Harappan sites are scattered across an area extending from northern India through Pakistan and into Afghanistan, contemporary sites without Harappan material remains are also found throughout this area. The subsistence system of the Harappan period consisted of food production with some hunting, fishing, and plant gathering. The archaeobotanical database for this period is more extensive and of higher quality than in the previous period. Macrobotanical data from nearly 15 sites (including Harappa) indicate the cultivation of a variety of plants (table 3). Wild plants are found throughout this period and probably served as a dietary supplement and for medicinal purposes (Vishnu-Mittre 1985). Among the domestic animals represented in archaeological assemblages cattle are more numerous than sheep and goats (Meadow 1989, 1996). There is some indication of the broadening of plant use through some interregional borrowing and the extension of the cultivation period by multicropping. Yet each region still focused on either winter or summer cultivation depending on the environment. Although this was a period of cultural integration, there was still considerable variation in subsistence systems. It is during this period that the first African millet occurs.

Finger millet (*E. coracana*) is present at the beginning of the Harappan period. To date, no seeds of this plant have been found prior to 2600 B.C. This millet exists initially in the peripheral or frontier regions of the civiliza-

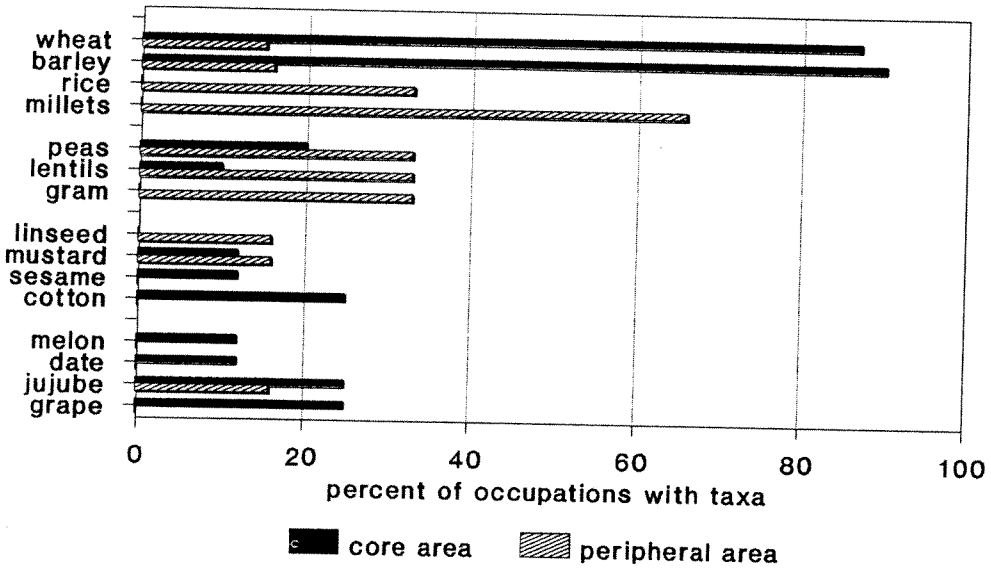

FIG. 3. *Crop plant distributions from 53 sites in northwestern South Asia during the 3d millennium* B.C. Core area, *the central area of the Harappan civilization (the Indus Valley, including Sind and Punjab);* peripheral area, *the civilization's frontier (Gujarat, Haryana, and Baluchistan).*

tion—Gujarat, Haryana, and Maharashtra—and areas that have been traditionally dependent on *kharif* rather than in core areas such as Punjab, Sind, or other parts of the Indus Valley. At sites in Gujarat such as Rojdi, *ragi* does not seem to have replaced any food plant or significantly changed the socioeconomic system (Weber 1992). Instead, it seems to have been added as a supplemental crop where millets were already playing a role. Analyzing the database according to number of seeds per liter of soil, the relative abundance of a specific taxon in a given assemblage, and the percentage of samples from which a specific taxon was recovered shows that by the end of this period a combination of finger millet, foxtail millet, and little millet dominated the archaeobotanical record in the peripheral areas (fig. 3) (Kajale 1991, Weber 1992).

The shift from the Harappan to the Late Harappan period, beginning at about 2000 B.C., did not occur at the same time, at the same pace, or in the same way everywhere (Possehl and Raval 1989). The Late Harappan period (lasting from around 1700 to 1300 B.C.) is associated with a divergence of regional material culture from the standardized traditions of the Harappan period. There appears to have been an increase in settlements and a rise in regional systems that were no longer integrated by a single ideological and economic system (Kenoyer 1991). Although many urban sites were abandoned, many attributes of the Harappan culture persisted into later times (Kenoyer 1991). Regional stylistic zones are reminiscent of the diversity of the Early Harappan period.

This process of cultural diversification contrasts with the constant but more gradual change seen in the subsistence system. Broadening of the plant base continued, but nearly all the plants exploited had been in use in some region of northwestern South Asia during the preceding period. Particular species assumed greater importance in some regions than in others; while multicropping was becoming the dominant practice, people still emphasized one season and therefore a specific set of plants over others.

Two new millets, large millet (*S. bicolor*) and pearl millet (*P. typhoides*), were introduced into South Asia from central Africa during this period, initially in areas where other millets were already being cultivated (Costantini 1981, Reddy 1991). Older finds indicate that they played a minor role in subsistence at first, just as finger millet had earlier. By the end of this period, more sites contain large millet and pearl millet, and seeds are recovered in greater numbers (Weber 1992, Kajale 1991).

A MODEL FOR THE INTRODUCTION OF AFRICAN MILLETS IN SOUTH ASIA

South Asians have a long history of access to foreign goods and nonindigenous plants. Millets were just one of a number of species introduced during Harappan times; other domesticates included grapes, dates, peas, lentils, and mustard (Costantini 1981, 1990; Kajale 1991). Since the Harappan economy was to a great extent based on trading (Kenoyer 1992), there were many opportunities for new taxa to enter the area. Sites on the Arabian Peninsula have yielded millets of African origin at dates earlier than those in South Asia, suggesting that millets entered the subcontinent by a coastal route.

The interactional sphere involving Africa may have been open constantly or periodically for the duration of

the Harappan civilization. Currently, the evidence suggests that African millets came into South Asia at two points, one in the 3d millennium B.C. and another in the 2d millennium B.C. The first introduction involved finger millet and occurred at the same time that foxtail millet was introduced from East Asia. Both new millets were introduced into subsistence systems oriented toward summer cultivation, in which little millet was already established. Finger millet and foxtail millet were both closer in size to little millet than they were to the millets introduced later. Once the new millets were established, all three millets together, as a summer-cultivation package with or without *Chenopodium*, spread into areas like the Indus River valley, where subsistence was oriented toward winter cropping. At the same time, winter-cropped plants such as lentils, linseed, and jujube were added to the subsistence strategy in many of the peripheral regions where the *kharif* system was well established. As multicropping became the rule, subsistence systems in most regions of northwestern South Asia incorporated many more of the same plants. Millets were well established throughout much of South Asia by the end of the Harappan period.

The second wave of African millets, including both large millet and pearl millet, hit South Asia in the Late Harappan period, when multicropping systems using similar plants were already in place. Both new species were cultivated, processed, and used in ways familiar to South Asian farmers, but they produced larger seeds in taller plants. Sorghum eventually assumed a dominant position in South Asian subsistence systems, but this took several centuries. There is no evidence of any dramatic shift away from old species where these millets were introduced. The initial use of African millets was not associated with an agricultural crisis and did not stimulate a shift in settlements and material culture.

SUMMARY AND CONCLUSION

Our knowledge about African millets in South Asian subsistence systems can be summarized as follows:

1. Prior to the 4th millennium B.C. there is no evidence for African millets in South Asia. They were introduced in the 3d and the 2d millennium B.C.

2. African millets were introduced into subsistence systems that were already using a summer-cropping strategy that included millets.

3. Initially, African millets played minor roles in subsistence, but by the middle of the 2d millennium B.C. they were significant cultigens in all parts of South Asia.

4. There is no evidence that the appearance of African millets is associated with shifts in the material record or settlement systems.

During the Early Harappan period, where we see regional variation in material culture, agricultural systems were also variable. Where the soil and climate were less favorable for the winter cultivation of wheat and barley, people began growing a variety of hardy, summer-cropped plants that included a variety of local millets. With the development of extensive trading networks, more shared material culture, and larger spheres of interaction in the Harappan period, the agricultural system remained much the same but more crops were exchanged and *rabi* and *kharif* plants coexisted in some settlements. New crops came in from outside South Asia, including the first African millets. These plants were used first in areas dependent on the *kharif* pattern, into which they could be easily incorporated. Their initial impact was minor. Multicropping increased in importance, including, among other plants, the new millets, but preference for the primary cropping season in any given region persisted and the same cereal grains dominated agriculture as in the previous period. During the Late Harappan period, when we see more regional variation in the material culture, the expansion of multicropping led to a more uniform subsistence strategy, with wheat, barley, oats, peas, lentils, chickpeas, linseed, jujube, and brown mustard cultivated in the winter and rice, millets, grapes, cotton, dates, hyacinth beans (common beans), and horse, black, and green gram in the summer. The remaining two African millets, large millet and pearl millet, entered South Asia at this time, at first in areas where millets and rice were the dominant cereal grains. Their use gradually spread, and by the middle of the 2d millennium B.C. all three African millets had assumed the importance in South Asian agriculture that they have had in recent times.

This scenario fits both the material and the paleoethnobotanical record and can readily be verified (or falsified) by future research on new data. Some unanswered questions remain, such as why these plants arrived at different points in time and how the East and West Asian interaction spheres were integrated in Harappan practice. Continuing and interconnected exploration of the archaeobotanical and material records offers us the best chance of answering them.

References Cited

COSTANTINI, L. 1981. "Palaeoethnobotany at Pirak: A contribution to the 2nd millennium B.C. agriculture of the Sibi-kacchi Plain, Pakistan," in *South Asian archaeology 1979*. Edited by H. Hartel, pp. 271–77. Berlin: Dietrich Reimer Verlag.

———. 1990. "Harappan agriculture in Pakistan: The evidence of Nausharo," in *South Asian archaeology 1987*. Edited by M. Taddei, pp. 321–32. Rome: Istituto Italiano per il Medio ed Estremo Oriente.

DE WET, J., AND J. R. HARLAN. 1972. The origin and domestication of *Sorghum bicolor*. *Economic Botany* 25:128–35.

DOGGETT, H. 1970. *Sorghum*. London.

———. 1989. "A suggested history of the crops common to Ethiopia and India," in *Late prehistory of the Nile Basin and the Sahara*. Edited by Lech Krzyzaniak and Michal Kobusiewicz, pp. 27–47. Poznań Studies in African Archaeology 2.

HARLAN, J. R. 1976. "Plant and animal distribution in relation to domestication," in *Early history of agriculture*, pp. 13–26. Philosophical Transactions of the Royal Society, London (Botany) 275.

———. 1989. "The tropical African cereals," in *Foraging and farming*. Edited D. Harris and G. Hillman, pp. 335–43. London: Unwin Hyman.

———. 1992. "Indigenous African agriculture," in *The origins of agriculture: An international perspective.* Edited by C. W. Cowan and P. J. Watson, pp. 59–70. Washington, D.C.: Smithsonian Institution Press.

HUTCHINSON, J. 1976. "India: Local and introduced crops," in *Early history of agriculture,* pp. 129–41. Philosophical Transactions of the Royal Society, London (Botany) 275.

JACOBSON, J. 1986. "The Harappan state: An early state," in *Studies in the archaeology of India and Pakistan.* Edited by J. Jacobson, pp. 137–74. New Delhi: Oxford IBH Publishing Company.

JARRIGE, J. F. 1985. "Continuity and change in the North Kachi Plain at the beginning of the second millennium B.C.," in *South Asian archaeology 1983.* Edited by J. Schotsmans and M. Taddei, pp. 35–68. Naples: Istituto Italiano per il Medio ed Estremo Oriente.

KAJALE, M. D. 1991. "Current status of Indian palaeoethnobotany: Introduced and indigenous food plants with a discussion of the historical and evolutionary development of Indian agriculture and agricultural systems in general," in *New light on early farming.* Edited by J. M. Renfrew. Edinburgh: Edinburgh University Press.

KENOYER, J. M. 1991. The Indus Valley tradition of Pakistan and western India. *Journal of World Prehistory* 5:1–64.

MEADOW, R. 1989. "Continuity and change in the agriculture of the Greater Indus Valley: The palaeoethnobotanical and zooarchaeological evidence," in *Old problems and new perspectives in the archaeology of South Asia.* Edited by J. M. Kenoyer, pp. 61–74. Madison: Prehistory Press.

———. 1991. "The domestication and exploitation of plants and animals in the Greater Indus Valley, 2nd–7th millennium B.C.," in *Forgotten cities on the Indus.* Edited by Mulloy M. Jansen and G. Urban, pp. 51–58. Mainz: Verlag Philipp Zabern.

———. 1996. "The origins and spread of agriculture and pastoralism in northwestern South Asia," in *Agriculture and pastoralism in Eurasia.* Edited by D. R. Harris. London: Institute of Archaeology, University College London.

NAYAR, M. P. 1985. *Meaning of Indian flowering plant names.* Dehra Dun: Bishen Singh, Mahendra Pal Singh.

POSSEHL, G. L. 1986. "African millets in South Asian prehistory," in *Studies in the archaeology of India and Pakistan.* Edited by J. Jacobson, pp. 237–56. New Delhi: Oxford IBH Publishing Company.

POSSEHL, G. L. AND M. H. RAVAL. 1989. *Harappan civilization and Rojdi.* New Delhi: Oxford IBH Publishing Company.

REDDY, S. 1991. "Complementary approaches to the Late Harappan subsistence: An example from Oriyo Timbio," in *Harappa excavations 1986–1990: A multidisciplinary approach to third millennium urbanism.* Edited by R. Meadow, pp. 127–36. Madison: Prehistory Press.

SEETHARAM, A., K. W. RILEY, AND G. HARINARAYANA. 1989. *Small millets in global agriculture.* New Delhi: Oxford IBH Publishing Company.

THOMAS, K. D. 1983. "Agricultural and subsistence systems of the third millennium B.C. in North-West Pakistan: A speculative outline," in *Integrating the subsistence economy.* Edited by M. Jones, pp. 279–313. British Archaeological Reports International Series 181.

VISHNU-MITTRE. 1985. "The use of wild plants and the process of domestication in the Indian sub-continent," in *Recent advances in Indo-Pacific prehistory.* Edited by V. N. Misra and P. Bellwood, pp. 118–23. New Delhi: Oxford IBH Publishing Company.

WEBER, S. A. 1990. "Millets in South Asia: Rojdi as a case study," in *South Asian archaeology 1987.* Edited by M. Taddei, pp. 333–48. Rome: Istituto Italiano per il Medio ed Estremo Oriente.

———. 1991. *Plants and Harappan subsistence: An example of stability and change from Rojdi.* Boulder: Westview Press.

———. 1992. "South Asian archaeobotanical variability," in *South Asian archaeology 1989.* Edited by C. Jarrige, pp. 283–90. Madison: Prehistory Press.

———. 1996. Distinguishing change in subsistence and the material records: The interplay of environment and culture. *Asian Perspectives* 35:155–64.