Naveena NL, Subramanya S, Setty RS (2016) Traditional grain storage practices among *Soligas* of Karnataka, India. Pp. 481–485. In: Navarro S, Jayas DS, Alagusundaram K, (Eds.) Proceedings of the 10th International Conference on Controlled Atmosphere and Fumigation in Stored Products (CAF2016), CAF Permanent Committee Secretariat, Winnipeg, Canada.

Traditional grain storage practices among *Soligas* of Karnataka, India

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ABSTRACT

Indigenous grain storage practices are economically viable, eco-friendly and location specific. In recent times, they are fast disappearing due to advancement in grain technology. However, these indigenous grain storage practices are still in practice in tribal areas. This may be due to the failure of extension activities in reaching the new technologies in grain storage practices to the needy or higher application costs. Tribal communities of the country play an important role in nation's food security. '*Soligas'* — a forest dwelling tribe living in small settlements called *Podus* in the Biligirirangana Hills, Karnataka, India practice subsistence agriculture and store the grains by their own traditional methods. The *Soligas* use different types of traditional storage structures, namely thenemane, maize (*Zea mays* L.) cobs tied to overhead ropes, mud pots, bamboo basket, gunny bags and cloth bags for safe storage of food grains. They also adopt different grain protection measures, viz. frequent drying, red earth smearing, mixing lime powder, neem (*Azadirachta indica* A. Juss) leaf, use of *lakkisoppu* (*Vitex negundo* L.), mixing *kaadugeru* seeds (*Semicarpus anacardium* L.), mixing of dry chillies (*Capsicum* sp.), mixing ash of *mattimara* [*Terminalia crenulata* (Heyne) Roth], mixing ash and smearing of castor (*Ricinus communis* L.) oil to protect the grains from various stored grain insects. This study sought to evaluate the different structures and grain protection measures, and grain damage by stored grain insects (SGI) which varied from 30 to 70%. The results revealed that none of these storage structures were suitable for safe storage of grains, as they had one type of disadvantage or the other; not being airtight, nor moisture proof, not insect or rodent proof.

Key words: Plant products, *Podus*, *Soligas*, Stored grain insects, Traditional storage structures

Indigenous Knowledge (IK) is unique to a particular culture and society. It is the basis for local decision making in agriculture, health, natural resource management and other activities. Learning from IK, by investigating first, what local communities know and have can improve the understanding of local conditions and provide a productive context for activities designed to help the communities (Dunkel and Sears, 1998). Throughout history, many cultures have used natural products from plants to protect themselves, their crops and their livestock against insects (Dunkel and Sears, 1998).

Traditional storage methods adopted by farmers are well anchored in the culture of local people. However, they seem to be ineffective in containing the heavy losses caused by pest infestations. Effective storage plays an important role in stabilizing food supply at the household level by smoothing seasonal food production. However, despite significant advances in food storage methods, many communities still rely on traditional storage methods for food, fodder and seed. Although these traditional storage methods are being relatively simple and inexpensive to construct and maintain, lead to substantial post-harvest losses.

Biligirirangana hills (BR Hills) is spread over an area of 540 km^2 in Chamarajanagara district of Karnataka, India. It had wide variations in elevations (700 - 1,800 msl) and vegetation (dry deciduous to wet evergreen forests) as a result temperature and relative humidity varies with the elevations. *Soligas*, a

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semi-nomadic tribe have been living in the BR Hills in settlements called, *Podus* which are distributed across the forest (Naveena et al., 2015).

The *Soligas* engage in shifting cultivation to grow a variety of crops within the forest areas of BR Hills. While practicing shifting cultivation, *Soligas* used to burn the land, the ash of the burnt plants added nutrients to the soil. However, after resorting to settled agriculture, they do not add nutrients either through organic or inorganic fertilizers. *Soligas* are still practicing the traditional cultivation practices which were followed during the shifting cultivation. In the present study, we documented and analyzed the storage structures and grain protection measures followed by *Soligas* to safeguard their food grains.

MATERIALS AND METHODS

The Biligirirangana Hills (BR Hills) (77°-78°E, 11°-13° N) are in the southeast corner of Chamarajanagara district in the Karnataka, India. The BR Hills is a point where the Western and the Eastern Ghats meet. The reserve has an undulating terrain, a network of valleys, and a number of hills (Anon. 2016).

About 57 *Soliga Podus* have been identified in BR Hills, and are spread across different altitudes and forest types. Of these, 30 individual *Podus* were selected as sampling units for the present study. The *Podus* were selected in such a way that all the isolated *Podus* and *Podu* clusters were represented (Fig. 1).

Grain sample collection from Soliga *households*

Regular visits were made to the selected *Podus* for about two years, to collect the infested grain sample and carried out a detailed questionnaire survey to elucidate information on storage structures used and grain protection measures followed by *Soligas* and were photographed for documentation purpose.

At each of the *Soliga* house visited during the study, about 100 g infested grain samples stored in those storage structures with different protection measures were collected in a polyethylene pouch, later transferred to the laboratory and stored in a plastic container for further study. The grain samples were analyzed for the damage and per cent grain damage was calculated.

RESULTS AND DISCUSSION

Storage structures used by Soligas

During the survey, about 263 *Soligas* from 30 *Podus* were contacted to know the grain storage practices being followed by them across BR Hills. It was found that the *Soligas* use 13 different types of storage structures, viz. thenemane, plastic woven sac, biscuit tin, metal drums, steel box, steel bins, plastic pot, plastic box, mud pots, cloth bag, bamboo basket, gunny bags and maize cobs tied to overhead ropes.

Among the different structures observed, plastic woven sac was the most commonly used grain storage unit by *Soligas*, being used in 28 out of 30 selected *Podus* (93.33%), followed by gunny bags (16 *Podus*; 53.33% of selected *Podus*), mud pots (16 *Podus*; 53.33% of selected *Podus*) and maize cobs tied to overhead ropes within houses (8 *Podus*; 26.67% of selected *Podus*), while the least used structures were—thenemane (1 *Podu*; 3.33% of selected *Podus*) and plastic pot (1 *Podu*; 3.33% of selected *Podus*). Use of such storage structures appears to be common in tribal and rural areas across the globe. Similar practices (square or rectangular shaped earthen containers and bamboo baskets) were observed in the tribal farmers in Hoshangbad and Chindwara districts of Madhya Pradesh (India) (Arjjumend, 2004). Traditional storage structures like Ningei, Kei, Kot, Apuachouba, Chujak yum and Chujakmapun are used by *Kabui* tribes in Manipur (Barwal and Devi, 1993). Mud rhombus, thatched rhombus and underground pit were the common storage structures existing in Sudan Savannah zone of Nigeria for storing millets, sorghum [*Sorghum bicolor* (L.) Moench], maize and cowpea [*Vigna unguiculata* (L.) Walp.] (Adejumo and Raji, 2007) as similar to the structures (Ragiguli, thenemane and thombe) used by *Soligas*.

The grains stored in these storage structures were found being infested by stored grain insects. An analysis of the grain samples stored in these storage structures indicated that the level of insect infestation ranged from 31 to 70% (Table 1), indicating that the different structures used did not effectively aid in controlling insect infestation of grains stored in them. Highest infestation was found in grains stored in cloth bag (70.06%), followed by gunny bags (64.19%) and mud pots (53.27%).

An evaluation of these structures for the safe storage of grains reveals that, none of the traditional storage structures were found to be suitable for safe storage of grains as they had one or the other type of disadvantages like not airtight, neither moisture proof or insect or rodent proof. The structures which are more recent types had more tight lids and were rodent proof, but they failed to provide protection against insects (Table 1). Survey of literature indicates that this has been the case in all situations where a traditional or local method of grain storage has been practiced. The gunny bags, *gumme*, *hagevu*, *vadevu* and earthen pots were common practices to store the grains in tribal

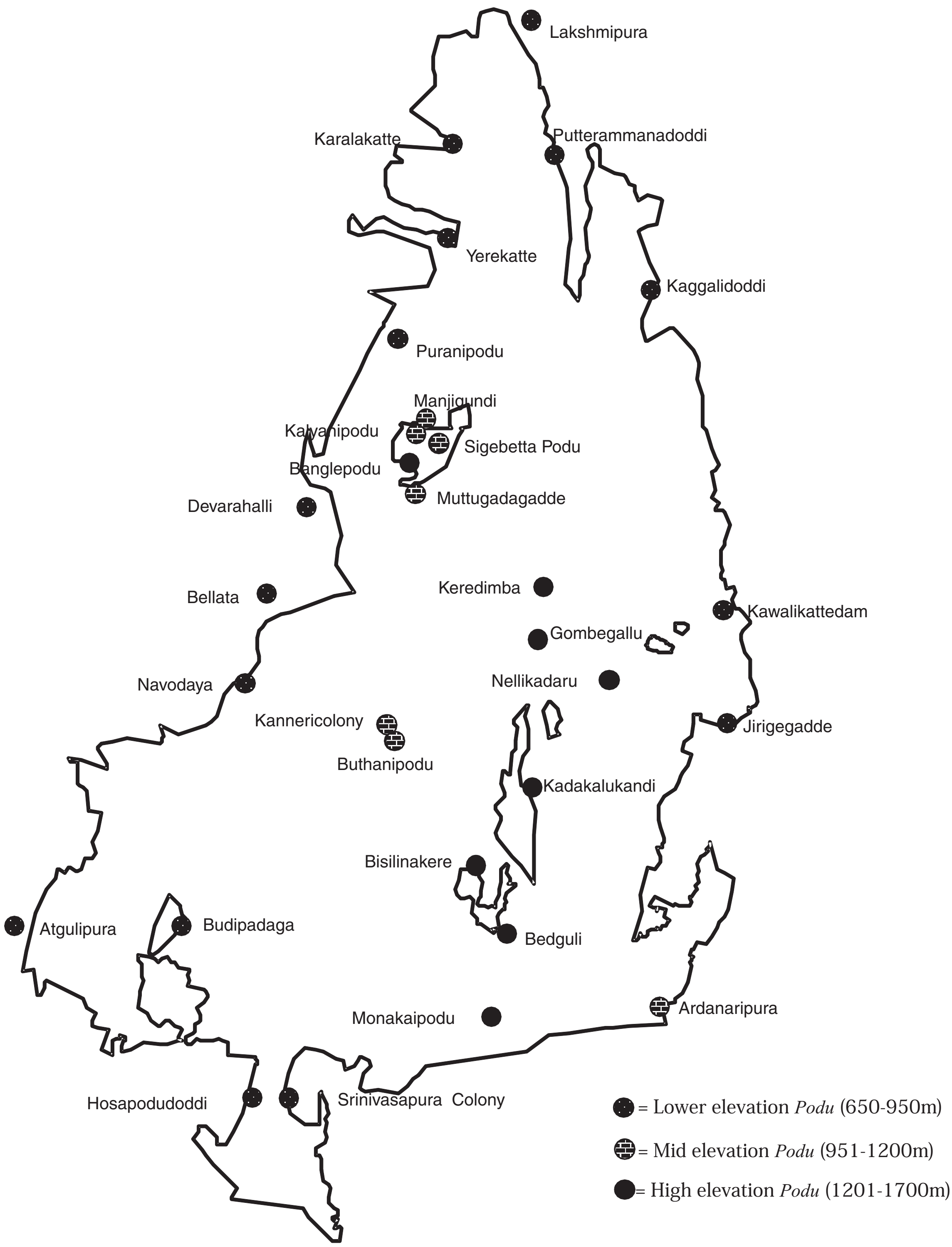

Fig. 1. Details of the study area

and under developed areas in Northern Karnataka and among these structures, earthen pot was the only rodent proof structure, while *hagevu* and *vadevu* were found to be insect proof (AICRP-PHT, 1992).

Grain protection measures used by Soligas

Soligas adopted 10 different grain protection practices, viz. frequent sun drying, mixing ash, red earth smearing, mixing *kaadugeru* (*Semicarpus anacardium* L.) seeds, use of lakkisoppu (*Vitex negundo* L.), mixing dry chillies (*Capsicum* sp.), mixing ash of *mattimara* [*Terminalia crenulata* (Heyne) Roth], mixing lime powder and smearing neem (*Azadirachta indica* A. Juss) and smearing castor

Table 1 Extent of insect infestation in storage structures used by Soligas *

Storage structures	Insects observed	*Soligas* using the structure (#)	Presence of infestation (%)	Grain preservation practices	*Soligas* using the practice (#)	Presence of infestation (%)
Thenemane	*Sitophilus zeamais* (Motschulsky)	12	41.67	Frequent drying	241	35.27
Maize cobs tied to overhead ropes	*Sitophilus zeamais*, *Carpophilus dimidiatus* (L.)	180	48.89	Red earth smearing	234	56.41
Mud pots	*Callosobruchus chinensis* L.	214	53.27	Mixing lime powder	23	47.83
Bamboo baskets	*S.oryzae* (L.) *Cryptolestes ferrugineus* (Stephens), *Tribolium castaneum* (Herbst)	29	41.38	Neem leaves	25	36.00
Gunny bags	*Callosobruchus theobromae L.*, *Stegobium paniceum* L. *Sitotroga cerealella* (Olivier)	215	64.19	Use of *lakkisoppu*	173	56.07
Cloth bags	*C. analis, Corcyra cephalonica* (Stainton) *S. cerealella*	157	70.06	Mixing *kaadugeru* seeds	68	33.82
Plastic woven sacs	*Lasioderma serricorne* (Fabricius), *C. chinensis*	220	53.18	Mixing of dry chillies	49	46.94
Biscuit tins	*S. zeamais, C. theobromae*	36	33.33	Mixing ash of *Terminalia crenulata*	28	32.14
Metal drums	*S.cerealella, S. oryzae, C. theobromae*	91	42.86	Coating the grain with castor oil	37	34.12
Steel boxes	*Rhyzopertha dominica* (Fabricius), *S. paniceum*	98	37.76			
Steel bins	*C. theobromae, S. paniceum*	45	31.11	Mixing with ash	157	42.68
Plastic pots	*C. analis, C. theobromae*	10	40.00			
Plastic boxes	*L. serricorne, S. paniceum*	129	34.11			

*N = 263

(*Ricinus communis* L.) oil over the grains for safe storage of grains. Despite the use of these methods, it was found that insect infestation still persisted up to 56.00% among the samples collected. Among the practices followed, mixing of *T. crenulata* ash revealed considerable protection to grains (32.14 % infestation), followed by mixing of *kaadugeru* seeds with grains (33.82 % infestation), coating the grains with castor oil (35.14 % infestation) and mixing with ash (42.68 % infestation). The highest percentage of infestation was found in grains coated with red earth (56.41% infestation), followed by the use of lakkisoppu (56.07 % infestation) and mixing lime powder (47.83 % infestation) (Table 1). Similarly, in Ethiopia alone, Tadesse and Eticha (1999) reported 25 traditional grain preservation practices for stored maize.

Analysis of grain samples collected from the *Soliga* households stored in different storage structures and grain preservation practices, revealed that *Soligas* were unable to store their grains safely and experience considerable grain loss, which may be up to 70% in certain cases. Thus, a detailed study of the grain storing practices by *Soligas* at BR Hills indicates that their grain preservation practices which are traditional do not help in any way to store their food grains safely. As a result, there is a need to improve the grain storage methods practiced by *Soligas* in BR Hills by educating them about use of proper storage structures like metal or plastic bins with tight lids, which effectively prevent moisture migration and are insect and rodent proof. Such structures would effectively prevent cross-infestation. Since *Soligas* were not even aware that the primary source of infestation is mainly through field infestation, there is a need to educate them and make them understand the nature and source of stored grain infestations and the methods of removing the same and subsequent scientific method of storing their grains. However, in the present process of developmental, increasing environmental concerns and emphasis on evergreen revolution institutionalization of Indigenous Traditional Knowledge is necessary to reap its immense utilitarian value as they are sustainable and eco friendly.

ACKNOWLEDGEMENT

We would like to thank *Soligas* of BR Hills and Karnataka Forest Department for the kind co-operation during the study period. Staff members of ATREE field station are remembered for their support.

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