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Weaver Ants Convert Pest Insects into Food - Prospects for the Rural Poor

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Abstract
In tropical plantations weaver ants feed on and control pest insects and can at the same time be harvested and eaten. In this way harmful pests are turned into valuable protein food and crops are protected without chemicals. As the weaver ant distribution envelops most of the worlds hunger hot spots this double utilization of ants for increased food production may benefit the people most in need. Further, the technology is simple and requires no external inputs and may thus be implemented among resource poor smallholders.

Introduction
A sustainable realization of food security is a major challenge in a world with a steadily increasing human population and a simultaneously increasing demand for protein (Boer et al 2006). The number of undernourished people in the developing world has recently increased to more than 1 billion people representing almost 20 % of the population in this part of the world (FAO 2009) and posing a problem not only to human health and well being, but also undermining efforts to reach the other Millennium Development Goals (FAO 2002). Sustainable and at the same time more efficient agricultural systems providing higher yields and preferable higher protein returns are called for, in particular in developing countries where the needs are highest. In tropical plantations these requirements may be met by the help of weaver ants (*Oecophylla* spp.) as the ants can function as biological control agents and at the same time comprise a protein food source.

Weaver ants belonging to the genus *Oecophylla* consist of two species - the African weaver ant *O. longinoda* and the Asian/Australian weaver ant *O. smaragdina*. These arboreal ants build nests in the canopy of their host trees by weaving together the leaves with silk produced by their larvae. In the canopies they forage for arthropod prey including pest insects and are known to protect 12 woody crops against more than 50 different arthropod pests (Way & Khoo 1992). They are increasingly being implemented as a substitute for chemical pesticides as they often are equally or even more efficient in controlling pests and at the same time are cheaper to use. For example, substituting conventional spraying programs with *O. smaragdina* biocontrol has lead to increased net incomes of more than 70% in Australian cashew and mango plantations (Peng & Christian 2005; Peng, Christian & Gibb 2004), up to 40% increases in Vietnamese citrus (Joachim Offenberg, Nguyen Thi Thu Cuc and Decha Wiwatwittaya, unpublished results) and in Ghanaian cashew *O. longinoda* has matched the use of chemical pesticide formulations (Dwomoh et al. 2009). Even higher benefits may be derived if the alternative is no chemical control as is often the case among smallholders. Ant biocontrol can lead to increased fruit yields but also the technology

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may stimulate a change to organic production as chemical pesticides become dispensable. Organic production, then, based on a holistic approach where synthetic fertilizers are substituted by organic manure may further increase yields due to an improvement of the poor soils often found in developing countries (UNEP-UNCTAD 2008).

A second way to utilize weaver ants is to use them as food as described by Sribandit et al (2008). This tradition has been practiced in Southeast Asia for centuries and is especially well developed in Thailand where weaver ant harvest in a single province has been estimated to amount to 105 ton ant larvae year^{-1} worth US$ 620,000. As the ants live in dense colonies and their leaf nests are highly visible in the canopies of trees, ant larvae are easy to locate and harvest. During the harvest season 4-5 kg of ant larvae can be harvested day^{-1} person^{-1}. Further the ants have a protein content of 48.5% (dry weight) which is similar to e.g. chicken eggs and they are a priced delicacy approximately twice as expensive as common protein food such as chicken and beef (Sribandit et al 2008). Ant larvae are even exported to Asian stores in Japan and Europe. Similarly, weaver ant larvae are used as human food in a number of developing countries, including Vietnam, Indonesia, Myanmar, Philippines, India, Cameroon and Congo (Offenberg & Wiwatwitaya 2009 and references therein). While there is a western reluctance to eat insects, probably the majority of the worlds remaining human population is regularly eating ants or other insects which in these parts of the world contribute with significant amounts to the total animal protein intake (DeFoliart 1999). Weaver ants therefore do not only possess an opportunity to increase crop production indirectly by means of pest control, but may also contribute directly to food and protein security in its capacity of being an animal foodstuff.

Traditionally ant biocontrol has been practiced in orchards whereas ant harvest has been based on uncultivated catchments with natural ant populations. In a recent study from a Thai mango plantation, however, it was found that ant larvae could be harvested without losing the pest control afforded by the worker ants (Offenberg & Wiwatwitaya 2009). As mainly queen larvae were harvested, which are leaving their natal colonies anyway, workers ant densities and colony survival was not reduced by the harvest. In contrast, long term worker ant densities actually increased in the harvested ant colonies compared to the un-harvested. Thus ant biocontrol was sustainable integrated with ant harvest and a double benefit of the ants was achieved. In the same study it was found that ant larvae yields ranged between 114 and 377 g ant larvae (fresh weight) tree^{-1} year^{-1}, the former if ants were left to feed on pests and other insects and the latter if ants were provided additional food.

In the present paper we explore the prospects of this integrated approach to combat hunger among the world's rural poor by: (i) examining the distribution of weaver ants and matching this distribution with the worlds hunger hot spots and (ii) extrapolating the ant harvest yields obtained from Thailand.

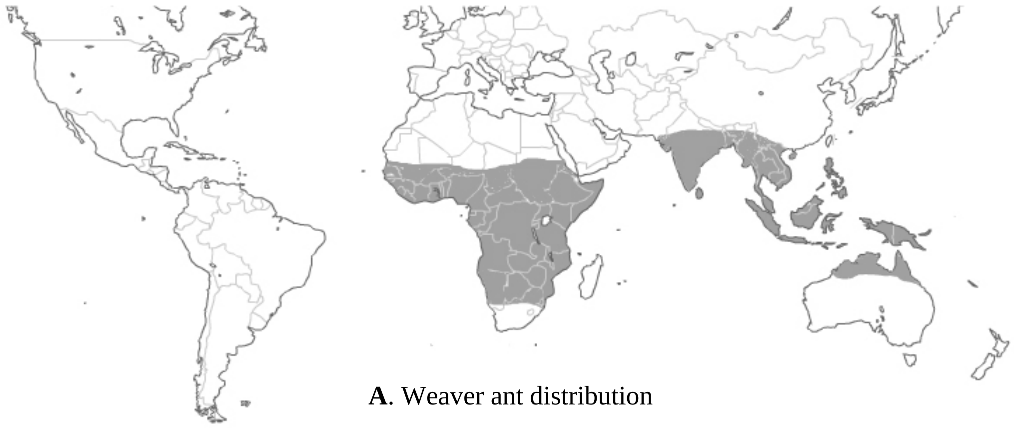
Materials and Methods

The geographic distribution of weaver ants was based on the description given by Cole & Jones (1948) and the hunger hot spots of the world were identified from FAO (2002). Ant harvest yields presented in Offenberg & Wiwatwitaya (2009) were given on a per tree basis. Since all trees in the study were readily colonized by the introduced weaver ants we extrapolated tree yields to hectare yields by calculating the tree density using the spacing between the mango trees from this particular plantation.

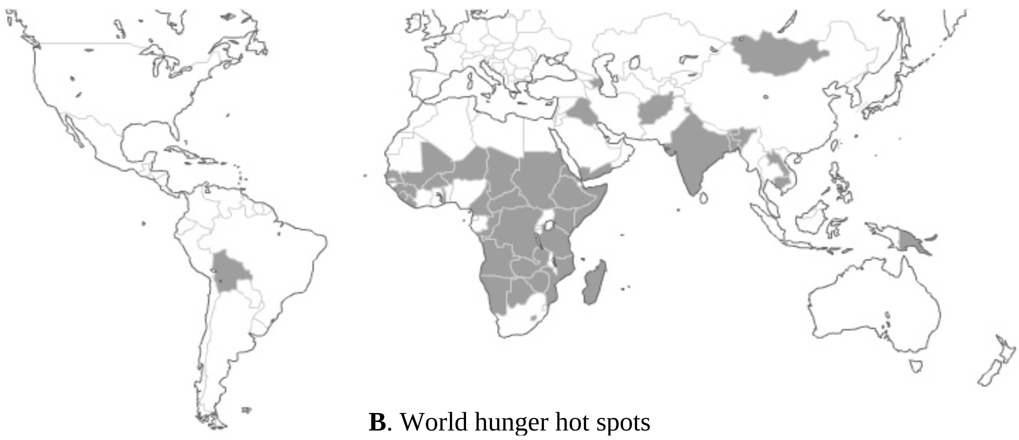
Results

The distribution of weaver ants and human hunger are shown in figure 1. Weaver ants cover most of the Old World tropics (Cole & Jones 1948) and envelop the majority of the countries having the highest rates of chronic hunger (FAO 2002). Weaver ants are native to more than 80 percent (37 out of 45) of the countries where more than 20% of the human population is undernourished and 75 or more out of every 1000 children die before the age of five.

In the Thai mango plantation tree spacing was 6 x 6 m, leading to 278 trees hectare^{-1}. Therefore yearly yields of 114 to 377 g tree^{-1} corresponded to hectare yields from 32 kg ant biomass under unmanaged conditions to 105 kg if the ants were provided additional food.



A. Weaver ant distribution



B. World hunger hot spots

Figure 1: The geographic distribution of weaver ants and the highest rates of hunger. **A**. The distribution of weaver ants is marked in grey. *O. longinoda* is native to tropical Africa while *O. smaragdina* is native to Asia and Australia. **B**. Countries where more than 20% of the population are undernourished and 75 or more out of every 1000 children die before the age of five is marked in grey.

Discussion

There is considerable overlap between those parts of the world where people are most in need of food, and the distribution of weaver ants and their potential to be utilized as a supplementary food. This overlap further match with cultural affinities for insect eating which is common throughout the tropics and subtropics (DeFoliart 1999). The utilization of ants as a human food is therefore not a major challenge in these countries; as outlined in the introduction, weaver ants are already custom food in a number of developing countries. Furthermore, implementation of the weaver ant technology among the rural poor may be eased by the fact that the technology is readily available and “low tech” - the ants are native and therefore already present in the surrounding environment and management of the ants require no external input, but knowledge. Basically what is needed to manage the ants in an orchard is simple knowledge on ant biology and, based on this, keeping track of the individual colonies. Trees occupied by the same colony are then interconnected with strings, twigs or lianas to facilitate migration and trees belonging to different colonies are pruned to avoid inter-colony fights via canopy connections. Manuals on weaver ant management targeting poorly educated farmers are already available in English, French, Vietnamese, Bahasa Indonesia and with Khmer being considered (Van Mele & Cuc 2007; Paul Van Mele personal communication). The technology is therefore not restricted to larger plantations but is equally relevant to resource poor smallholders. Based on these findings it is evident that an opportunity exists to utilize weaver ants to reduce food insecurity among some of the more than 1 billion people starving today.

As ants can be harvested from plantations and orchards without the loss of pest control, ant yields of 32 kg ha^{-1} achieved without ant feeding are costless and need no investment except the time used to harvest the ants. WHO (2003) estimates that sub-Sahara African meat consumption average 9.4 kg $capita^{-1}$ $year^{-1}$. Thus one hectare orchard producing more than 30 kg ant "meat" $year^{-1}$ will more than double three peoples' intake in this region. In this scenario the ants turn insects into edible high protein food. One problem – the pest insects – is turned into the solution of another problem – protein shortage.

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