SPECIAL ARTICLE

Local technicians in long-term research projects: evaluation of 25 years experience in an active tropical research station

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Abstract: Most field ecology is conceived and financed by scientists from urban areas but is actually carried out in rural areas. Field staff can either be imported from urban areas or recruited from local residents. We evaluated the advantages and disadvantages of involving rural residents as local technicians over a 25- year period at active field research site in Costa Rica. We defined "local technicians" as local residents with no university education who acquired significant experience in field data collection, data management and/or laboratory work. We analyzed the experiences of incorporating these technicians into field research in developing countries from the points of view of scientist and of the local technicians themselves. Primary data were written responses from to a standardized survey of 19 senior scientists and Ph.D. students, and results from standardized personal interviews with 22 local technicians. Researchers highlighted the advantages of highly-skilled technicians with minimal staff turnover, as well as the technicians' knowledge of local ecological conditions. Local technicians considered the primary advantages of their jobs to be opportunities for continuing education training in science as well as cultural enrichment through interactions with people of different cultures. The main challenges identified by researchers were the lack of long-term funding for projects and extended training required for local technicians. Local technicians can be of great benefit to research projects by providing high-quality data collection at reasonable costs with low staff turnover. Over the last 25 years the research model at the field station we studied has evolved to the point that most long-term projects now depend heavily on local technicians. This model of involving local technicians in long-term research has multiple benefits for the researchers, the technicians and the local community, and could be adapted to a variety of settings in rural areas of developing countries. Rev. Biol. Trop. 59 (4): 1455-1462. Epub 2011 December 01.

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Most ecological scientists of both developing and developed countries are residents of urban areas, but most tropical field research takes place in rural areas. Many researchers who carry out field research in rural areas of the tropics need assistance with the field work. One solution is to use volunteers or graduate students brought from urban areas, essentially importing all the necessary person-power and expertise to the field site. Another approach is to develop the human resources in rural areas by training local residents to the point where they can work as research technicians.

Here we define "local technicians" as residents of rural areas adjacent to research sites. These technicians have no formal education beyond high school, and the skills necessary to work as research technicians are provided by training from researchers. The term "parataxonomist" was coined by Janzen (1991)

to describe a local resident trained through interaction with academic scientists, and who develops a career collecting and processing biological specimens. Parataxonomists also generate natural history information for the inventory site where they are residents (Janzen *et al*. 1993, Longino & Colwell 1997, Basset *et al*. 2000). At our study site, at the La Selva Biological Station in the Atlantic lowlands of Costa Rica, residents of the local community have been involved in research projects for more than three decades in biodiversity inventories but also in a broad range of field research activities.

Several different approach to training local people as research assistants for long-term research in the tropics have been described (Janzen 1991, Janzen *et al*. 1993, Bassel *et al*. 2000, Campbell & Rojas 2000, Janzen *et al*. 2004, Longino & Colwell 1996), but there are few quantitative data on the roles and experiences of local people as technicians in ecological research projects. We were interested in evaluating the model of using local people in research projects with a systematic interview process to generate quantitative metrics of the results. We wanted to understand the point of view and lessons learned by the scientists during the process of training and employing local technicians, as well as the viewpoints of the local technicians themselves.

MATERIALS AND METHODS

Our study area was La Selva Biological Station (10°26' N - 83°59' W, 35-137m.a.s.l.), on the Caribbean slope of the Cordillera Central, Costa Rica. It has been owned and managed by the Organization for Tropical Studies (OTS) since 1968, and is one of the most active tropical rain forest research sites in the world (McDade *et al*. 1994).

Our survey was carried out through interviews using a list of twelve questions for both scientists and local technicians (Appendix). Our sample included senior scientists and Ph.D students who had trained and incorporated local people into their research projects. We initially contacted approximately 30 scientists by e-mail, of whom 19 responded. The interviews for scientists were done by e-mail in English with responses directly to the senior author. This analysis included not only the experiences at La Selva (n=16) but also experiences with researchers in two other research sites in Costa Rica, Las Cruces Biological Station (n=2) and Guanacaste Conservation Area (n=1). Twenty two local technicians were interviewed via personal interviews in Spanish. The senior author conducted the local technicians interviews for all who were not under her direct supervision (n=17); the others (n=5) were interviewed by an environmental education staff member of La Selva to minimize bias.

The questions were similar for scientists and local technicians regarding to benefits, strengths, weaknesses and lessons learned of being involved in a research project (Appendix).

RESULTS

The scientists' experiences using local technicians ranged from 4-40 years (n=19, X±SD=14±3.6), while participation of local technicians in the research projects ranges from 3 to 25 years (n=22, X±SD=10±6.3).

From the scientists' point of view, the principal advantages of employing local technicians were having highly-skilled assistants with long-term availability and excellent knowledge of local ecological conditions (Table 1). In contrast, the local technicians reported that the principal advantages were the opportunities for continuing learning and for interactions with scientists (Table 1).

Scientists reported that the principal disadvantage of using local technicians was the difficulty of providing long-term funding to insure the employee's job stability (Table 1). Most local technicians (55%) did not find any disadvantage of working in a research project, but some agreed with the scientists that long-term job security was an issue, because every 3-5 years they face the possibility of losing their jobs.

TABLE 1

Percentage of total responses about the advantages and disadvantages of having technicians involved in tropical field research according to scientists and local technicians. Sample sizes were 19 researchers and 22 local technicians

Advantages for scientists	%	*Advantages for local technicians*	%
Highly skilled staff	84	Continuing biological and scientific education	86
Long-term availability (minimal staff turnover)	79	Meeting and interacting with people from different cultures	84
Good local ecosystem knowledge	74	To be part of a crew that generates scientific knowledge	59
Reliability and quality control of data collection in the field	68	Good salary and benefits	54
Experienced guides that facilitate work in remote locations	63	Opportunity to work with scientists	50
Knowledge of local resources and logistical aspects	58	Opportunity to let other researchers know their skills	36
High field work efficiency	42	To feel their work is valuable	36
Good networks of collaborations with peers on other projects	26	Working in an environment where they feel comfortable	31
Strong team spirit	21	Flexible time, final products are more valuable than hours worked	18
Contribution to the local economy of the region	21	Local outreach by hosting visitors	14
Cost effective	21	Working near their homes	14
Disadvantages for scientists		*Disadvantages for local technicians*	
Lack of secure funding to ensure job security	100	None	55
Training period takes longer	63	Uncertain job stability	46
Need for consistent supervision	53	Need to abandon academic studies in order to work	27
Barriers in terms of scientific knowledge	42	Some duties require extensive time affecting personal life	18
Lack of English skills and communication	37	No real understanding of the project goals (lack of education)	18
Inability to oversee each step of the data collection process	26	Long walking alone in remote places	11

The principal tasks of local technicians in field research were data collection and other tasks that didn't involve project design or data analysis (Fig. 1). Technicians carried out a very broad array of jobs including tree inventories and monitoring, vouchers preparation, basic surveying with a leveled transit, GPS mapping and georeferencing, litterfall collection and sorting, soils and roots sampling, basic chemical analyses, arthropod sampling, invertebrates specimens preparation, taxonomic identifications, bird sampling, water sampling, use of a wide variety of scientific instruments and specialized computer programs and data entry.

The skills that scientists were looking for in local technicians fit with what local technicians said about their own skills. These main skills were the technician's commitment to perform careful, reliable and honest work in data gathering, as well as their knowledge of local ecosystems (Table 2).

Specific characteristics that were considered by the scientists before hiring local technicians were: willingness/ability to learn new skills (46%), good attitude for interacting with co-workers and scientist of various cultures (31%), good recommendations from other researchers (30%), long-term availability (26%), ability to read and write legibly (16%), creativity to solve minor problems (10%) and dependability (10%).

Most local technicians reported that they have received some type of training from the lead scientists or from another experienced technician (72%). The major training topics were basic ecological knowledge and skills in data collection and data entry. More than 50% technicians received training directly in the field, and 45% checked and verified the data collected and entered them into digital databases.

Personal initiative seems to be the key element for successful training according to 46% of local technicians. Learning materials, such as herbarium specimens, computer-based plant images, sample collection, consulting with local experts and written materials were also helpful.

Most (89%) local technicians agreed that the best way to guarantee that high-quality data are collected was to carefully follow protocols and methods taught by the scientists.

Fig. 1. a. Field surveying using a laser range finder for plot layout and tree mapping; **b.** Water and aquatic insect sampling; **c.** Arthropod processing (ants separation and labeling) in lab; **d.** collecting vegetation samples in the field for identification and vouchers.

TABLE 2
Percentage of total responses about local technicians' skills evaluated by scientists and local technicians. Sample size was 19 researchers and 22 local technicians

Technicians' skills cited by scientists	%	Technicians' skills cited by themselves	%
Quality work (careful, reliable and honesty)	100	Careful, rigorous and organized	64
Extensive knowledge of local flora and fauna	95	Taxonomic expertise	59
Hard field workers	58	Local field knowledge and experience	55
Samples processing for analysis	53	Hard field worker	37
Basic computer use for data entry	42	Equipment and computer management	27
Plot setup and site maintenance	37	Willingness to learn	27
Excellent intuitive understanding for the organism	8	Ingenious and initiative	22
		Good relationships	5
		Good memory and good observer	5

Most researchers (89%) addressed the lack of university-level education with some type of training. These researchers gave detailed instructions through an initial training and supervision in particular skills, as well as working extensively and directly with the technicians in field data collection. A majority of the scientists (58%) used some method to insure data quality control; the strategy of quality control depended on the specific task performed. Examples

of quality control included on-going checks on plant species identifications by experts; the use of blind re-measurements to check measurement precision, cross-checking between different techniques as comparing data collected by different technicians; checking up data as soon after being collected to assess consistency and promoting multiplicity of functions so specific skills are shared by more than one technician.

Most researchers (87%) commented on the development of cross-cultural knowledge. The researchers recognized that working with people from different cultural backgrounds and the interactions with local technicians was stimulating for both their research and their personal development.

The major lesson learned by local technicians (68%) was understanding that responsibility and honesty with data were the important issues in research, while 59% reported that their jobs led to a change in their attitudes towards conservation.

DISCUSSION

These results suggest that involving local technicians in field research has mutual benefits for both the researchers and the local technicians. The main advantages for scientists are that trained local technicians collect high-quality ecological data and are reliable long-term employees. A fully trained parabiologist is a highly-skilled employee and his/her work can greatly extend the range of possible field activities for a given project. This strategy can provide a cost-efficient way to carry out field research, because the researchers are able to delegate on-going data collection with high confidence in the reliability and quality control of the field data. Having local workers as local technicians makes it easier to run long-term field operations, and it allows the development of personal networks between technicians that can foster a supportive and productive research environment.

The experiences in Costa Rica have shown that this model of using local technicians can work well in stable political environments where the local people can read, write and have basic computer skills. It is an open question how this model would work with local residents who are not literate. Literacy clearly makes everything easier, but in some situations technologies like digital voice recorders and cameras could be used to circumvent illiteracy. Local technicians can have important skills that scientists are looking for to carry out field research. Nevertheless, successfully employing local technicians depends to some extent on how well-organized the researcher is, and how well she or he is able to communicate the tasks that the local technicians need to complete. The accumulated knowledge on many aspects of local ecosystems (i.e. familiarity with species distributions, local names and uses, natural history) also adds ecological context to the research, and can lead to increased work efficiency (e.g. an experienced local technician can work in remote locations and difficult field conditions, can help to maximize the time spent in the field and help find a suitable place to start the field work). In addition, local technicians may have a better idea than outside researchers of what is feasible in terms of field work under local conditions.

High levels of unemployment for men and particularly for women are very common in rural areas of developing countries. Incorporating local people into research projects contributes economically to the area surrounding the research site, particularly if technicians' salaries increase as their specialized skills increase. In addition to acquiring scientific knowledge and intellectual challenges not present in other available jobs in the area (for example working in agricultural plantations), local technicians may also earn higher salaries than those generally available in rural labor markets.

One significant challenge for keeping skilled local technicians is securing the funding required to sustain a long-term research effort in the field and to cover the technicians' costs (salary, benefits and station fees). Recognizing the difficulties of maintaining steady funding, some of the interviewed researchers wanted to develop more training opportunities

for technicians to increase their employment opportunities after a particular project ends.

The lack of post high-school education did not appear to be a major obstacle for successfully employing local technicians to carry out a wide variety of research activities. Although the technician's limited scientific training/knowledge clearly imposes some limits the degree to which they can be involved in some research activities (statistical analysis, writing for publication), a more important result is just how many technical skills can be learned without advanced formal education. We have commonly observed that local technicians soon exceed their mentors in the skills they learn. This is not surprising, given that the technicians frequently accumulate many more hours of experience than their mentors in making routine measurements or using particular pieces of scientific equipment.

Nevertheless, the quality of data obtained by expert local technicians depends crucially on their training and on-going support. Feedback and on-going oversight by researchers are necessary for ensuring data quality and for maintaining a successful working relationship. Researchers need to provide theoretical knowledge, provide and teach quality control, and teach the specific specialized techniques for each project (e.g. tree measurements, mist netting and bird banding work, surveying principles, use of scientific equipment, laboratory sample processing and computer skills).

Once local technicians start working independently, other methods of quality control are advisable, such as careful supervision with frequent back-checking of recently collected data to assess consistency (e.g. data checking against standard values, checking data collected on field sheets and data entered on spreadsheets), as well as periodic review in the field.

Post-data-collection quality control can be maintained in some cases using standard statistical methods to compare data collected by technicians (e.g. continuing data summary categories including tables and figures where is possible to check outliers or unusual patterns or trends). Errors or irregularities of data inputs can be detected using data screening programs.

In terms of the lessons learned by researchers who involved local technicians in their projects, development of cross-cultural knowledge was one of the most rewarding aspects. It means that local technicians are very important not only for their careers but also for their lives due to the cultural enrichment interacting with them.

In addition, incorporating local people into research activities offers an excellent opportunity to involve them in changing local perceptions and attitudes towards conservation. There is considerable potential for using local technicians as role models in environmental education for the entire community. The technicians are likely to be able to transfer their knowledge about the research findings and implications in a way that is easily understood by the local public. They can also help generate local political support for the research site.

Research stations should consider developing avenues for stimulating incorporation of local residents into research program. Researchers benefit for all the reasons we have documented. In addition, the local technicians can become agents for public outreach. As a result, the field station can become better integrated in the broader community framework and provide a positive local impact both financially and educationally. Research is a human enterprise and as such proceeds better or worse depending on many factors other than the academic level of the participants. Twenty five years experience at La Selva with involving local residents as research technicians has shown that this is a sustainable and mutually-advantageous way to carry out research in rural areas of developing countries.

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Supporting Information

List of questions used in this survey to carry out the interviews for both scientists and local technicians is available in the Appendix. The authors are solely responsible for the content and functionality of this material. Queries (other than absence of the material) should be directed to the corresponding author.

APPENDIX

List of questions used in this survey to carry out the interviews for both scientists and local technicians

Questions for researchers

1. Have you used local technicians in your research projects at La Selva? If so, how many years of experience do you have working with local technicians?
2. What are the advantages of having technicians involved in tropical field research?
3. What are the disadvantages of having technicians involved in tropical field research? Can these disadvantages to be addressed?
4. What were the principal role and responsibilities of local technicians involved in your projects?
5. What are the most important skills of the local technicians involved in your research project? Did you have to teach them these skills?
6. What were the criteria to select local technicians for your project?
7. Did you have to address the fact that local technicians had no university education in science?
8. Did you develop methods to insure quality control of the data collected by local technicians? If yes, please briefly describe them.
10. Which are the main challenges to insure the employee's job stability and to keep them involved in the project for a long term?
11. What are the most important lessons you've learned by involving local technicians in your projects?
12. Do you think that involving local people affects community attitudes towards environmental conservation (beyond those of the local technicians involved)?

Questions for technicians

1. ¿Cuántos años tiene trabajando como técnico local en proyectos de investigación?
2. ¿Qué tan importante piensa ud que es su trabajo para los proyectos de investigación donde ud ha trabajado?
3. ¿Cuáles son las ventajas de estar involucrado en proyectos de investigación a largo plazo?
4. ¿Cuáles son las desventajas de estar involucrado en proyectos de investigación a largo plazo?
5. ¿Cuál ha sido su principal función y responsabilidad en este tipo de trabajo?
6. ¿Cuáles son sus más importantes habilidades que ud ha usado en un estos proyectos en donde ha trabajado?
7. ¿Qué hace ud para asegurar la calidad de los datos que ud recolecta?
8. ¿Qué clase de entrenamiento ha recibido ud para mejorar sus habilidades y conocimiento científico?
9. ¿Cuáles son los principales retos que ud encuentra como técnico local?
10. ¿Qué cosas lo motivan a ud a continuar involucrado en un proyecto de investigación?
11. ¿Cuáles son las lecciones aprendidas más importantes al estar involucrado en un proyecto de investigación?
12. ¿Piensa que usted tiene una actitud diferente hacia el ambiente desde que esta involucrado en un proyecto de investigación?