The Economic Importance of Wild Resources in the Hadejia-Nguru Wetlands, Nigeria

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Abstract

The Hadejia-Nguru Wetlands play a major role in the regional economy of northern Nigeria. Recent attempts have been made to value the production of most of the major sub-systems of the Hadejia-Jama'are floodplain, including irrigated farming, flood and rainfed agriculture, fisheries and livestock. However there is little information on the economic role of other wild resources harvested from the floodplain. This paper presents the results of a training workshop and field study undertaken to assess

the economic importance of the major wild resources harvested within the Wetlands using participatory appraisal techniques. The aim of the study was to provide new information for development planning in the region by increasing the understanding of local economic activities. A variety of values, including financial values, economic values and returns to labour, are complemented by extensive qualitative information on resource use. The paper also discusses how the study employed participatory appraisal techniques to investigate economic values: participatory methods were used more extensively than some other studies which have relied on conventional questionnaire-based surveys. Despite the modest research results, the findings reveal some promising possibilities for using such methods to generate numerical information.

Abrégé

Les bas-fonds de Hadejia-Nguru jouent un grand rôle dans l'économie régionale du Nigeria septentrional. Récemment, des efforts ont été faits pour évaluer la production de la majeure partie des grans sous-systèmes de la plaine d'inondation d'Hadejia Jama'are: culture irriguées, agriculture dépendant des inondations et précipitations, pêcheries et élevage. Mais il n'existe guère d'informations quant au rôle économique d'autres ressources sauvages récoltées en plaine d'inondation. Ce document présente les résultats d'un atelier de formation avec étude sur le terrain menée à l'aide de techniques participatives pour estimer l'importance économique des principales ressources sauvages récoltées dans les bas-fonds. Ce travail a eu pour objectif de mettre à la disposition de la planification du développement dans la région, des informations nouvelles améliorant la compréhension des activités économiques locales. Toute une gamme de données de valueurs - valeurs financières, valeurs économiques et rendements de la main d'œuvre - se trouvent complétées par des informations qualitatives étendues concernant l'emploi donné aux ressources. Le texte discute aussi de la façon dont l'étude a su exploiter les techniques de l'évaluation participative pour enquêter sur les valeurs économiques: les méthodes participatives furent plus largement utilisées que dans d'autres études s'étant appuyées sur des méthodes d'enquête conventionelles à base de questionnaires. Malgré la modestie des résultats de recherche obtenus, les conclusions révèlent de prometteuses possibilités d'emploi de ces méthodes dans la production d'informations chiffrées.

Resumen

Los pantanos de Hadejia-Nguru juegan un papel muy importante en la economía regional del norte de Nigeria. En la planicie aluvial de Hadejia-Jama'are se está intentando reconocer el valor de la producción de una gran parte de los más importantes sub-sistemas tales como la agricultura de regadío, de inundación y pluvial, la pesquería y el ganado. Es, sin embargo, muy escasa la información existente acerca del papel económico que juegan otros recursos naturales que se pueden exacter de Las policies alluvial. Est. MonogramfÍa present los resultados de un taller de entrenamiento y de un estudio de campo realizados para evaluar, mediante el uso de técnicas de evaluación participativa, la importancia económica de los principales recursos silvestres extraídos de los pantanos. El estudio tenía como objetivo proporcionar nueva información para la planificación del desarrollo regional al ampliar el conocimiento acerca de las actividades económicas locales. Un rango de valores que incluyen el financiero, económico y de rendimiento laboral son complementados por una extensa información cualitativa acerca del uso de los recursos. La monografía también se refiere a las técnicas de evaluación participativa que se utilizaron en el estudio para investigar los valores económicos. En este caso se empleó una mayor proporción de métodos participativos en comparación con estudios convencionales en los cuales la recopilación de información se hace predominantemente a través de encuestas a base de cuestionarios. Aunque los resultados de la investigación son modestos, éstos ilustran algunas posibilidades interesantes acerca del uso de dichos métodos en la generación de información numérica.

Introduction

The Hadejia-Nguru Wetlands play a major role in the regional economy of northern Nigeria. Recent attempts have been made to value the production of most of the major sub-systems of the Hadejia-Jama'are floodplain ie, irrigated farming, flood and rainfed agriculture, fisheries, and livestock (Barbier, Adams and Kimmage 1991, ICRA 1992, Hollis, Adams and Aminu-Kano 1993). However, there is little information on the economic role of other wild resources harvested from the floodplain.

The objective of the CREED Nigeria Hidden Harvest project was to strengthen the capacity of local organisations working in the Hadejia-Nguru Wetlands in conducting resource valuation at a community level. The project consisted primarily of a training workshop lasting three weeks in July 1995 and involving thirteen participants from a range of conservation, development and academic organisations (see Appendix B). Through the workshop and its associated field study, the participants sought to assess the economic importance of the major wild resources harvested from within the Wetlands using participatory appraisal techniques. This new information should be useful for planning activities in the floodplain region and for identifying areas requiring further investigation.

This paper has two purposes. First, it presents the research results of the study. The emphasis placed on capacity strengthening means that many questions regarding the economic importance of wild resources remain unanswered. Nevertheless, a variety of values, including financial values, economic values and returns to labour were estimated and these are complemented by extensive qualitative information on wild resource use. These estimates help to establish orders of magnitude for the actual values and indicate which areas deserve further research.

Second, the paper discusses how the study employed participatory appraisal techniques to investigate economic values. In collecting quantitative data, other studies (for example, Hot Springs Working Group 1994) have tended to rely on the use of conventional questionnaire-based surveys, while using participatory techniques to examine management and institutional issues. This study relied more heavily on participatory methods and, despite its modest research results, revealed some promising possibilities for using such methods to generate numerical information.

The paper consists of five sections. The next section provides some background information on the Hidden Harvest project and how this study fits into that initiative. A brief overview then presents the concepts of participatory rural appraisal (PRA). This is followed by a summary of available information on the Hadejia-Nguru Wetlands, and details of the major results of the study. The final section summarises these findings and also offers some conclusions on the methodology used.

Detailed comments recommending major changes to an earlier draft of this paper were received from a couple of the reviewers. Some of the comments provided were not consistent with those of other reviewers, hence it has not been possible to adequately address everyone's concerns

Economic Importance of Wild Resources

Studies from around the world illustrate how wild resources often form an integral part of livelihood (Scoones, Melnyk and Pretty 1992). Wild resources provide materials for utensils and construction, and contribute to improved diets and health, food security, income generation, and genetic experimentation. These resources are typically associated with hunting and gathering societies where they often have special cultural significance, but they also play important roles in more intensive or specialised agricultural systems.

Yet wild resources are often ignored and receive little recognition from the development community of policy makers, researchers and practitioners (IIED 1995). The use of wild resources may be hidden from outsiders as subsistence production and therefore not captured in conventional statistics. Even where such resources or their products are sold or commercialised, this trade may still be difficult to quantify. If these values are ignored, or assumed to be negligible, then decisions on development priorities and activities might be seriously misguided or inappropriate. The aim of the Hidden Harvest project, initiated by IIED's Sustainable Agriculture and Environmental Economics Programmes, is therefore to understand the importance of wild resources to rural people and to develop practical methods to make this value more visible. This methodology is being developed and tested in such a way that enhances the capacity of locally-based organisations to undertake such work themselves.

A recent review of studies on the economic value of non-timber forest products (NTFPs), which are often thought of as wild resources, points out that there is little consistency in the methodology being employed by these often multi-disciplinary efforts and proposes that the simple economic model of price less costs be followed (Godoy, Lubowski and Markandya 1993). This basic concept of value is linked to both conventional accounting frameworks, as in the case of cost-benefit analysis, and to more complex models

of household production. In a few instances, researchers have estimated the consumer surplus derived from wild resources using contingent valuation methods (for example, Shyamsundar, Kramer and Sharma 1995). While having the advantage of producing welfare-based measures, such methods are far more complex and present a number of practical difficulties.

The prices used in the net economic value approach can be varied, depending on the boundary of the analysis: farmgate, some wider administrative or economic region, or the whole country. Some studies simply calculate gross financial values; for example, de Beer and McDermott (1989) estimate the financial value of exports of wild resources from Southeast Asia. In such cases, researchers are more concerned with simply raising the profile of these otherwise `hidden', or `insignificant' resources. More recent studies concentrate on estimating the net economic value of wild resource production for a unit of land; this type of result could then be weighed against alternatives, such as in a cost-benefit analysis (see Lampietti and Dixon 1995, for a review of NTFP examples).

With wild resources, even relatively straightforward information, such as quantities collected, processed or sold, is not readily available. Collecting such data is generally a time-consuming task due to the high degree of geographic variability in the types and quantities of resources collected. Where wild resources are used exclusively for subsistence, price estimation may also present difficulties, although market prices of commercialised substitutes are often used. Thus, while detailed studies of individual communities have been produced, results that could be interpreted as representative of larger areas are far more scarce.

A major difficulty in estimating the economic value of wild resources concerns the opportunity cost of labour, which is usually the most significant input to the harvesting process. Studies tend to make very simple assumptions about this parameter, often with apparently little justification, even though it has a considerable effect on the resulting value. Looking for one value for the opportunity cost of labour is clearly too much of a simplification. The seasonality of production activities and the opportunistic nature of many harvesting activities mean that this value may vary quite widely, even within one community.

An alternative is to calculate the returns to labour[1] devoted to harvesting and processing various wild resources. Following this approach, the Hidden Harvest case study undertaken in Botswana analyses the different incentives which induce women to choose between harvesting either wild or cultivated palm leaves, which are then woven into baskets and other crafts (Bishop and Scoones 1994). Returns to labour reflect not only the value of the resource but also various institutional factors.

Aside from the financial or economic value generated by a natural resource, two other aspects are crucial for understanding its importance to rural livelihoods: *when* the benefit is enjoyed and *by whom*. Certain sources of food or income may be highly valued because they are available before the harvest when the previous year's stocks or revenues are running low. These seasonal changes in values will be reflected in rises and falls in prices where levels of commercialisation are higher.

On the other hand, distributional issues will not be reflected well in market prices. A modest source of income for more disadvantaged groups is considerably different from a similar amount earned by better-off community members with more diverse income-earning opportunities. Sophisticated techniques exist for comparing the income earned by different groups but where basic price and quantity data is often lacking, such methods are too ambitious (for example, see Squire and van der Tak 1975). The simpler alternative is to highlight to which groups income or rents accrue.

A somewhat different approach to valuation is taken by farming systems research, also described as agro-ecosystem analysis and on-farm research. This aims to value the components of the production system from the household's perspective. Although studies of farming systems have been criticised for focusing too strongly on the production of crops, the approach provides plenty of scope for investigating the value of wild and other natural resources in household production systems (for example, Juma 1987, Reynolds *et al.* 1991, Rocheleau *et al.* 1990,; see Scoones *et al.* 1992 for other examples)

[1] Although typically measured in terms of time, labour used in resource harvesting and processing should ideally measure effort (for example, with caloric units). But collecting such information is very time-consuming and can only be done in the context of a long-term study.

To collect information on wild resource use, researchers have generally combined a variety of conventional data gathering techniques, including questionnaire-based surveys, market surveys, time and motion studies, notebooks recorded by community members, etc. The most reliable of these methods require a large amount of time and resources, but yield fairly precise data sets for extensive statistical analysis. However in many instances less detailed information is required and/or less time is available; for example, in many project assessments or planning situations. In such cases, there is potential for making greater use of participatory assessment techniques, such as participatory rural appraisal (PRA). Emphasising the importance of local people's understanding of their environment, participatory research methods can be very appropriate for addressing the often `hidden' nature of wild resource use. IIED's Hidden Harvest project has sought to develop a methodology which uses a range of research approaches, including PRA and conventional social and biological science techniques.

The origins of PRA lie partly in the techniques devised to undertake farming systems research and this illustrates the conceptual link between the values which have been sought by PRA and the values which are sought by conventional research techniques. However, the dual conceptual and methodological nature of participatory approaches are often confused and the assumption that participation prevents quantification is frequent. One of the findings from this study is that the widely perceived dichotomy between economic and quantitative, on the one hand, and participatory but qualitative, on the other, is unnecessary. This study and other Hidden Harvest studies have combined different approaches in parallel so that each builds on the information provided by the other (Bishop and Scoones 1994; Hot Springs Working Group 1995; Guijt and Collins, forthcoming; IIED 1995). Each study provides another opportunity to experiment as it seems unlikely that a fixed or rigid sequence of methods would be appropriate in all circumstances.

Participatory Research Techniques

In terms of methodology, this study concentrated on the use of participatory research techniques. The aim of this section is to provide an introduction to the concepts of participatory research and highlight their relevance for valuing the hidden harvest. The choice of participatory research techniques for undertaking a study of this nature has several implications, two of which are examined here: the need to train a research team in their use (a valuable component of a capacity strengthening programme such as CREED) and the need to assess the quality of the research results.

Box 1 Participatory Research Concepts

1. The Value of Indigenous Knowledge.

Participatory research has both a philosophical and practical interest in indigenous knowledge. Many people who use participatory research tools do so because they believe that research should be at least partly a participatory process which involves, rather than exploits, the population being studied. In practice, this means that the views and opinions of local informants are paramount and should be understood. Researchers need to listen carefully to what informants have to say, and make an effort to understand the issues that confront them. (Schoonmaker-Freudenberger and Guèye, 1990)

2. Offsetting Bias.

Because PRA does not usually involve interviewing large samples of people, it is not possible to rely on numbers alone to guarantee a diversity of views. Special efforts have to be made to ensure that a range of opinions is represented and that all aspects of an issue are understood. In some situations, it is impossible to eliminate bias. Here participatory research acknowledges this and attempts to manage the effects of bias on the study. (Schoonmaker-Freudenberger and Guèye, 1990). This is achieved through explicit awareness of the context in which information is gathered (Pretty, 1993). Participatory researchers should be vigilant for sources of bias. Where bias exists, participatory research acknowledges this and seeks to understand the limits which it imposes on research findings.

3. Triangulation.

Examining an issue from only one angle incorporates serious bias into the analysis. Therefore, participatory research looks at the same issue from different angles (Mettrick, 1993):

i) PRA uses a variety of information gathering techniques: key interviews, group discussions, secondary sources such as aerial photographs, transects, direct observation in addition to the participatory research tools.

ii) PRA uses a variety of units of observation: individuals, households, farms, communities.

iii) PRA varies the composition of research teams so that their different perspectives can be brought to bear.

Participatory Research

Participatory research does not involve methodology alone; it embodies concepts which have been developed to enable outsiders to help meet the needs of resource-poor households and communities. Three important concepts form the basis of participatory research techniques: the value of local knowledge, offsetting bias and triangulation (see Box 1). These are interwoven with a variety of research methods to create an evolving body of participatory research techniques and tools.

The use of participatory research techniques to investigate the Hidden Harvest from the Hadejia-Nguru Wetlands has both conceptual and practical advantages. Conceptually, the hidden nature of wild resources warrants an approach that emphasises local-level knowledge and experience. Furthermore, certain participatory research tools, such as wealth ranking and seasonal calendars, are ideally suited to investigating the complex economic issues of `value to whom?' and when do they occur?'[2]. From a practical perspective, household and community-level values are a useful contribution to the community-awareness work of the Hadejia-Nguru Wetlands Conservation Project (HNWCP; see Section 4) and provide illustrative examples for their lobbying work at local and State government levels. But as illustrated by other Hidden Harvest case studies, the choice of participatory research methods does not exclude the use of other research methods (eg, Hot Springs Working Group 1995). Where estimates of resource values at a greater geographical scale are required, say for macro-level policy making, then the local-level values elicited through participatory research can reveal the nature of the relevant household production models and provide a basis for designing an appropriate sample survey.

Implications of Participatory Research

Although crucial conceptual issues guide the choice between participatory research and conventional sample surveys, notably the importance of local involvement in development planning, the most suitable methodology also depends on practical matters. As illustrated in Table 1, both participatory and conventional research techniques have important implications for the research process which need to be understood before the appropriate choices are made. Overall, the personal dimension of participatory research is where both its strengths and weaknesses lie. For example, participatory research encourages researchers to develop a personal rapport with informants which has both advantages and disadvantages; it can encourage the informant to give more thoughtful answers but at the same time can allow researchers to make their own personal judgements at an early stage. Similarly, participatory research enables simultaneous analysis and investigation, but drawing a line between analysing a

[2] Several of these techniques have been shown to provide a better representation of economic aspects of various communities than more conventional research methods, such as those which rely primarily on sample surveys. ActionAid Nepal found that participatory mapping for monitoring and evaluating their services throughout a rural development area proved more effective and more convenient than previous conventional surveys (ActionAid Nepal, 1992). In Tamil Nadu, the Christian Medical College undertook a comparison of wealth ranking with a formal survey for identifying the rural poor in one local council area. Wherever a discrepancy emerged between the results of the wealth ranking and the formal survey, the household concerned was revisited and extensive conversations held with the family members. The formal survey was found to be 57% accurate whereas wealth ranking was found to be 97% accurate (RUHSA, 1993). A forthcoming issue of *Participatory Learning and Action Notes* (published by the Sustainable Agriculture Programme of IIED) will focus on comparisons between participatory and conventional research methods.

response and making a personal judgement relies heavily on the skills and training of the researcher. The remainder of this section considers two of these implications in more detail: the training of participatory researchers and the assessment of participatory research.

Training for Participatory Research

While it is often possible for field assistants who have received only a few days of training to undertake sample surveys, participatory research requires skilled researchers throughout the entire field process. Furthermore, the unconventional nature of participatory research usually means that skilled researchers with training in participatory research methods are relatively scarce. This study, like many others which have utilised participatory research methods, first needed to train researchers in the use of PRA methods. This raises an important issue: undertaking meaningful research as part of the training process is extremely valuable in building the capacity of the trainees. However, during training where researchers are using participatory research techniques for the first time, the research cannot be perfect, if only because learning from mistakes is a vital part of the training process.

Assessing Participatory Research.

As with sample surveys and other methods of conventional research, the trustworthiness of studies using participatory research techniques needs to be assessed (Pretty *et al*., 1995). The criteria on which the integrity of conventional research is judged (internal validity, external validity, reliability and objectivity) are not appropriate for assessing participatory research as they rely on concepts such as confidence intervals and methods such as random sampling which are not used by participatory research. In response, Lincoln and Guba (1985) have developed four alternative criteria: credibility, transferability, dependability and confirmability. These have been adapted by Pretty (1993 and 1994) to address researchers' concerns about the quality of participatory research (see Box 2) and are used to assess this study in subsection on methodology issues in the final section.[3]

Table 1 Practical Implications of Participatory and Conventional Research Techniques

	Participatory Research Techniques	Conventional Sample Surveys
Skills	Require a high level of skill and several highly skilled people at each stage of the research process	Require a high level of skill for the design and analysis stages.
Training	The skills needed to design and facilitate are not widely available. Thorough training of field staff is usually required.	The skills required for design and analysis are relatively widely available. Training of field staff is usually undertaken in two or three days
Objectives	It can be difficult to adhere to research objectives as well as enable local people to participate in research planning and implementation.	Research objectives can be strictly adhered to.
Flexibility	Research can easily be adjusted to suit local circumstances as they emerge.	Any need for changes to the research plan can be complex and time-consuming to implement.
Rapport	The high value placed on community	The inability of local people to

[3] These four criteria primarily address the integrity of research as evaluated by the research or professional community. Community concerns are of equal significance in assessing participatory initiatives with broader learning and action goals. These concerns have been reflected in subsequent attempts to identify appropriate criteria for judging participatory processes of research and action (Lincoln, 1990; Lincoln and Guba, 1985; Pretty, 1994; Marshall, 1990; Smith, 1990). Pretty *et al*. (1995) have identified a framework for establishing trustworthiness which allows for a comprehensive evaluation of participatory learning and action. As this report is intended primarily for the research community, such an evaluation is not included here.

	Participatory Research Techniques	Conventional Sample Surveys
	participation enables the development of a good rapport with local people. This helps to ensure more honest and considered answers.	participate in research planning can lead to a lack of understanding and interest in the issues being investigated. This provides little encouragement for them to consider their answers carefully.
Representativeness	Uses purposive sampling for diversity to offset bias. The focus on diversity requires personal judgements which are transparent, although they can vary from person to person.	Uses random sampling to ensure objectivity. This explicitly avoids personal judgements, however, it can be difficult to ensure, without incurring very high field costs.
Analysis	Analysis is done concurrently with the investigation and requires the understanding of the research issue and the time of both the researchers in the community and local people. It allows for key issues and discrepancies to emerge and be followed up immediately.	Analysis can be and often is postponed to a time and place which is convenient to the researchers.
Aggregation	The co-ordination of time and skills required is difficult to conduct on a large scale and the focus on diversity is not well suited to generalisation. The awareness of local context can facilitate the transfer of findings to a wider area, but this depends on what aspects of the context are deemed to be relevant.	Sample surveys are designed for results to be applied to a larger population, the aggregation of results is implicit within this. Sample surveys facilitate the transfer of results to a wider area.
Acceptability	Participatory research techniques are not widely understood. Lack of knowledge can hinder the assessment of their findings where inappropriate criteria are applied.	Conventional sample survey techniques are widely known and understood. This enables their findings to be assessed easily.

Box 2 Criteria for Assessing Conventional and Participatory Research *Adapted from Lincoln and Guba (1985) and Pretty (1993)*

Internal validity concerns truth. To what extent do the results or the analysis of information gathered from a community represent what is actually the case? The ability to ensure the validity of research findings depends partly on the nature of the `truth' in question. For example, last week's firewood price is easier to verify than whether the price was considered to be fair. Where it is more difficult to establish the validity of a result, conventional research makes a judgement on this by comparing the level of variance within results against the variance of errors resulting from exogenous factors. In contrast, participatory research accepts that there can be no guarantee that a representation of certain issues within a community is either a valid one or the only one. PRA suggests the **credibility** of the research can be assured through establishing a rapport with participants, triangulating with, or cross-checking other sources of information, and analysing issues form different perspectives.

External validity concerns scaling up and applicability. To what extent can the research results be applied to a wider population? This issue is especially relevant to researchers who must justify the costs of what they are doing. If the research can be applied over a wider area, then the average cost per person will decrease and the research will be of better value.

Conventional research uses random sampling from a defined population to ensure that the findings from the sample can be scaled up and applied to the whole population. While not a crucial aspect, PRA practitioners do often expect that their conclusions will be transferable to other communities. But **transferability** can only be considered when researchers are aware of both the context in which PRA was conducted and of the context in which its findings will be utilised.

Reliability concerns replication. Will equivalent research procedures produce similar results and every time they are used? Conventionally, research is replicated and reliability proved or otherwise. PRA focuses on the **dependability** of its results by triangulating with various sources of information and using parallel investigations.

Objectivity concerns bias. Can multiple observers agree on a phenomenon? If they can their judgement is said to be objective. Conventionally, researchers use methods which aim to eliminate the influence of the researcher on the process and results of the research method. Similarly, the findings of a participatory inquiry should be cross-checked and confirmed through consultation of multiple sources. The **confirmability** of a PRA depends on the presentation of sufficient information for a disinterested reader to confirm that the findings are not a figment of the PRA team's imagination.

The Hadejia-Nguru Wetlands

The Hadejia-Nguru Wetlands is an extensive area of floodplain located in the north-eastern sudano-sahelian zone of Nigeria, covering an area of approximately 3,500 square kilometres. It is situated where two rivers (Hadejia and Jama'are) flow through a fossil dune field before converging and draining into Lake Chad (see Figure 1). The Wetlands play a major role in the recharge of groundwater in the Komadugu-Yobe Basin and also harbour large numbers of diverse species of wildlife, particularly Palaearctic and Afrotropical migrant water birds.

Figure 1 Location of the Hadejia-Nguru Wetlands

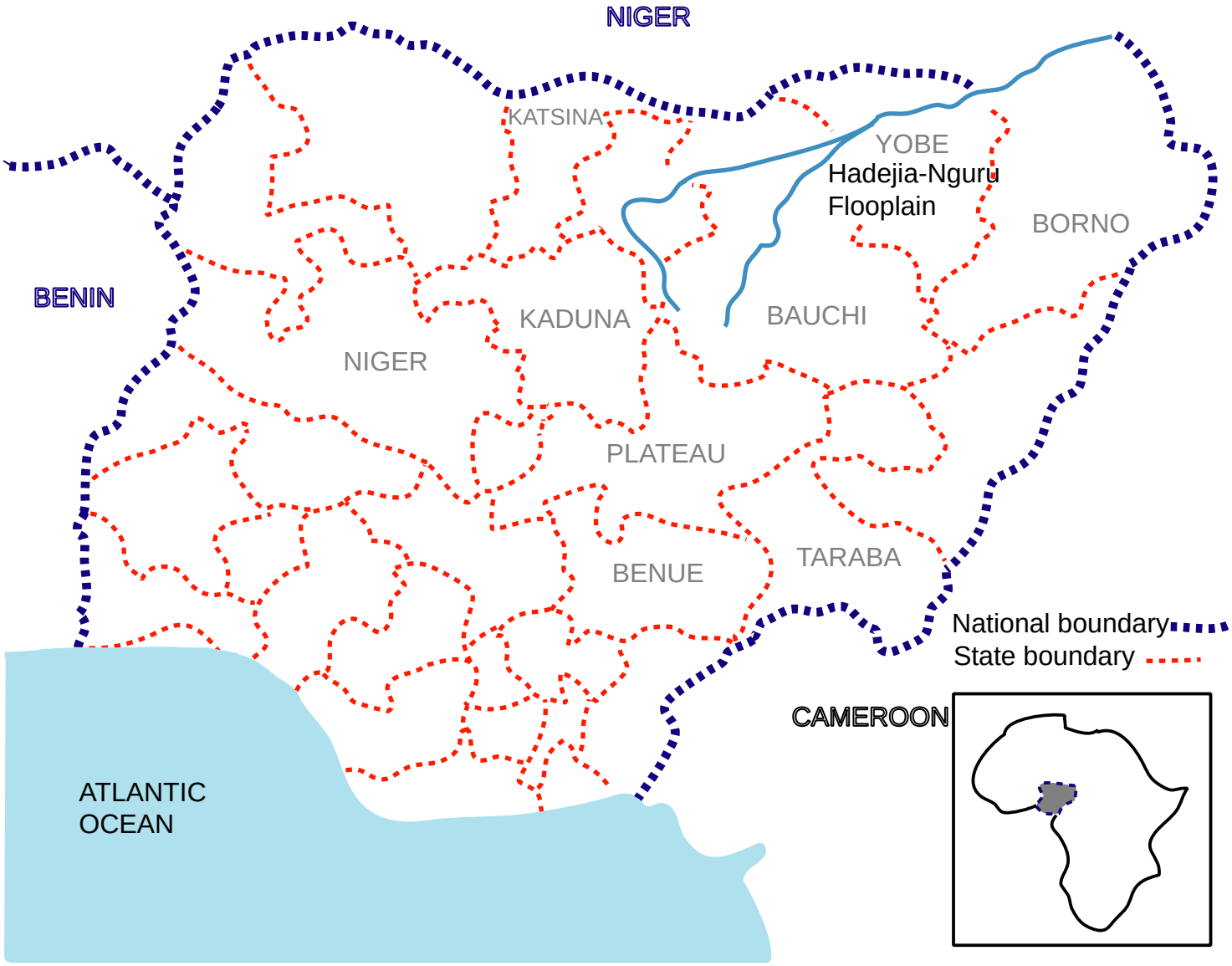
Source: Hollis *et al*. (1993)

The Wetlands have played a prominent role in the economy of the region for centuries, as evidenced by the historical importance of urban centres, such as Hadejia and Gorgoram. Adams (1993a) attributes this importance to annual flooding, which results in one of the most biologically productive areas in north-eastern Nigeria. This seasonal inundation supports the export of agro-pastoral surpluses and a higher density of population with relatively high levels of nutrition and income. During drought years, the importance of flooded areas increases, attracting many temporary immigrants from surrounding areas. In addition, the Wetlands play a vital role in the economy of the semi-nomadic Fulani pastoralists, who graze their livestock in the area during the dry season.

An estimated one million inhabitants live in the Wetlands with the predominant ethnic groups being the Hausa, Fulani, Kanuri and Bede; it appears as though a large number of people have immigrated since 1963, particularly during the years of severe drought in the region (Adams 1993a). The financial benefits of major agricultural outputs in the Wetlands has been estimated at approximately N6 billion (US$75 million; Barbier *et al*. 1993[4]), much of which is exported to other parts of the country. Over 250,000 heads of cattle are reared in the area, supporting a cattle trade with an annual turnover of over N400 million (US$5 million). An annual catch of over 6,000 metric tonnes of fish with a market value of N480 million (US$6 million; Barbier *et al*. 1993) is also provided by the Wetlands.

[4] The US$ amount was estimated by Barbier *et al*. (1993) for 1989-90 and then converted to Naira using the 1995 exchange rate (N80/US$).

Figure 1 : Location of the Hadejia-Nguru Wetland



Little has been documented about the Wetlands but it is clear that the area continues to evolve due to a variety of a factors (Adams 1993a). New and improved roads have led to a greater degree of integration with the regional economy. The increased commercialisation of production has also been stimulated through the arrival of technology such as petrol-powered water pumps. Adams (1993a) points out that land tenure patterns and institutions are changing rapidly, with the market for land developing quickly in response to recent legislation and increased commercialisation. Conflict over access to land has grown as agriculturists have sought to extend crop production through the dry season using irrigation on land that had been used by nomadic pastoralists for grazing (ICRA 1992). In addition, the National Parks Commission has already designated some parts of the Wetlands as components of the Lake Chad Basin National Park, although it is not clear what implications this has for land use options.

As in most areas of sub-Saharan Africa, the rights to many natural resources are influenced by both traditional institutions and newer rules established by the state. In some cases, as with tree-based resources, traditional management systems have been displaced by poorly-enforced government laws, so creating a vacuum. Limited evidence from previous work (Adams 1993b) indicates that certain trees, such as fruit trees, are held by high ranking members of the community but that access is easily available. During this study, the only response received on this issue was that farmers held the use rights to tree products in their field but, in general, any member of the community was free to harvest these resources. This indicates that fruits and tree leaves are still in abundance.

On the other hand, fuelwood has become the source of conflict. A number of forest reserves have been gazetted in the Wetlands. Evidence from both earlier studies (Adams 1993b, Barbier *et al*. 1993) and discussions conducted with communities during this research overwhelmingly suggests that these areas are being heavily exploited by commercial firewood harvesters catering for large urban centres, in some cases as far away as Kano. According to Adams (1993b), much of this activity is licensed by the State authorities whereas, during this study, even government-appointed forest guards in the village of Gwaiyo claimed that they do not have the capacity to reduce the excessive tree felling in the reserves by commercial cutters.

Recently, climatic vagaries and the construction and inefficient operation of large dams and other irrigation schemes upstream have greatly reduced the extent of annual flooding in the Wetlands. This directly undermines the economic and ecological functions of the area and is creating concern among downstream water users. Other proposed upstream water development projects would further impair the economic and ecological stability of the Wetlands in particular, and the whole Komadugu-Yobe Basin in general.

The Hadejia-Nguru Wetlands Conservation Project (HNWCP), under the management of the World Conservation Union (IUCN), seeks to maintain the economic and ecological functions of the Komadugu-Yobe Basin ecosystem by canvassing for support and co-operation from various parties to ensure regular flooding of the Wetlands. HNWCP is undertaking or promoting a number of studies on the hydrology, ecology and economy of the Wetlands in order to improve the scientific basis for managing resources of the entire watershed. The economic studies (of which this exercise forms a small part) aim to elucidate the financial and economic values of the ongoing production systems in the Wetlands in order to provide decision makers with a clearer understanding of the consequences of development.

Research was undertaken in two separate villages in the Wetlands -Adiani and Gwaiyo. The villages were selected on the basis of a number of criteria including general location within the Wetlands, distance from main roads and markets, type of natural environment, ethnic groups present and size. The aim was to choose two villages which had some differences but which would still allow some comparisons, as well as contrasts, to be made.

Adiani is located on the Hadejia River system while Gwaiyo is further east on the Katagum/Jama'are River system. One resulting difference is that the villages' economies are oriented towards different market towns. The two villages also differ in size with Adiani (approximately 4,500-7,000 inhabitants) being much larger than Gwaiyo (approximately 1,200). The main ethnic group in Adiani is the Mangawas and in Gwaiyo, the Bede. While both villages rely on fishing as a main economic activity, they are located close to major forested areas. These forest reserves provide an important harvest of wild resources, both for the villages and for the wider economy.

Results

The field study component of the project used PRA techniques to investigate the economic importance of wild resources in two Wetlands communities, Adiani and Gwaiyo.

Wild Resources Studied

The Hadejia-Nguru Wetlands provide a wide range of wild resources. During the detailed appraisal, just a few resources from each village were examined, including:

- doum palm
- potash
- firewood

The selection covers resources that generate significant monetary revenues for many groups within the communities, as well as others that directly benefit only a small group of individuals.[5]

Products of the **doum palm** tree are widely used and traded in the Wetlands, providing a source of food, materials and income for many different groups, including children, the elderly, the handicapped and full-time doum palm traders. While almost every part of the tree is used, the study concentrated on the sale of dried doum palm fronds. The fronds are harvested throughout the year with the peak times generally occurring at some point during the dry season. The fronds are used locally to make a variety of household products (mats, baskets, etc.). Bundles of dry leaves are also bought by traders and sold on to other markets. The fronds have some industrial uses as roofing material and there is a booming trade exporting fronds to Kano, some distance away.

Potash is traded in large quantities in the market towns of the Wetlands such as Gashua and Nguru, where it is sold as an industrial raw material first to wholesalers and then to traders from the southern parts of the country. In Adiani, potash is not traded on a commercial basis, but is collected during the dry season by a group of about 50 older women who sell it to other households throughout the year. Most households use potash in small quantities as a food ingredient, a stomach medicine and an appetite stimulant for livestock.

A large amount of the **firewood** collected in the Wetlands is destined for subsistence use, as it is the primary source of energy for most households. Both women and men engage in firewood harvesting. Women collect wood for their own use, as well as possibly for sale within the village, while men gather firewood primarily to generate income. There is also a very active trade, apparently conducted by outside commercial operators, that supplies firewood from the Wetlands to more distant towns and cities.

Harvesting firewood is most common during the dry season when the forest resources are more accessible and when other income earning opportunities diminish. Seasonal calendars drawn by younger

[5] Despite the overwhelming importance of fish in the Wetlands economy, the study did not examine animal resources due to the presence of another research effort concentrating only on that subject: Traditional Management of Artisanal Fisheries (TMAF) Project, conducted in collaboration by the Centre for Economics and Management of Aquatic Resources (CEMARE) at the University of Portsmouth (UK), the Department of Biological Sciences, University of Maiduguri (Nigeria), and the Federal University of Technology, Yola (Nigeria) and funded by the British Overseas Development Administration (ODA).

The study did examine wild foods which are an important part of the diet of almost everyone in the two villages. Some collect wild fruits and leaves for their household, and some buy them in the village market. Access to the fruits and leaves of most trees is free and the external inputs necessary to harvest them are low. In addition, the collection and marketing of wild fruits and leaves complements the seasonality of cultivated sources of food in both villages. Wild foods come into season during the rains or just afterwards, a time when food stores are at their lowest.

Unfortunately, most of the popular leaves and fruits were not in season during the fieldwork. This problem was compounded by the widespread involvement of many people in different capacities in the exploitation of wild foods, making these resources a complicated area to investigate for trainees. Thus, representative and reliable quantitative information on variables such as prices and absolute or relative amounts harvested and consumed was difficult to collect. Nonetheless, the study did identify the resources most deserving further research. Preliminary information also indicates that the relationship between a household's dependence on wild food sources and its wealth or income may not be that simple.

men involved in firewood harvesting further confirmed this by showing how prices and returns peak in the wet season when the supply of wood is scarcer. At this time of year, most people are busy planting and tending crops. In addition, they will have stocked up on firewood during the dry season. The results of a series of interviews with about a dozen firewood vendors indicates that the price of firewood in the wet season is almost double that of the dry season. But because of the difficulty involved in harvesting and transport, the firewood sellers generate much less revenue.

Using the information gathered, as well as secondary sources, returns to labour were estimated for harvesting each of these resources. These results are discussed in the following sections, followed by some tentative estimates of the aggregate market value of doum palm harvesting and potash collection in Adiani.

Returns to Labour

Using information from a variety of sources, the returns to labour for harvesting and selling three wild resources were calculated.[6] These estimates provide a rough indication of the relative value of these resources since the return to labour captures both the value of the resource and the opportunity cost of labour. Where the opportunity cost of labour, and hence the actual economic value, are too difficult to assess, returns to labour are useful for understanding the economic importance of an activity only in the context of other available opportunities for people's time. A higher return to labour represents a greater incentive to engage in that activity, although opportunities may be limited due to social, cultural or other economic factors.

Table 2 Returns to Labour from Harvesting Wild Resources

Resource	**Returns to Labour** (1995)	
	(Naira per day)[a]	(US$ per day) [a]
Doum Palm		
Harvesting Fronds (Adiani & Gwaiyo)[b]	200	2.50
Mat Production (Adiani)[c]	10	0.13
Firewood—carrying (Gwaiyo)[d]	40–60	0.50–0.75

[6] The returns to labour are simply the revenues less any relevant fixed or variable costs per unit of time devoted to the activity. Fixed costs, such as equipment necessary for harvesting, can be depreciated over the lifetime of the item, although for the resources examined, the fixed costs were in all cases negligible. Labour is ideally measured in terms of effort (for example, in caloric terms) but this can only be achieved with a much more indepth, long-term and intrusive study.

[a] One work day is approximately six or seven hours for agricultural labourers. This amount was fairly consistently quoted by informants throughout the Wetlands in both rural and urban areas.

[a] One work day is approximately six or seven hours for agricultural labourers. This amount was fairly consistently quoted by informants throughout the Wetlands in both rural and urban areas.

[b] The returns to labour from harvesting doum palm fronds were estimated using a variety of data sources. In Adiani, resource specific maps and process charts were drawn by a group of young and middle-aged male doum palm collectors. These revealed the time required for doum palm collection and the revenue generated. In addition, semi-structured interviews with another group of male doum palm collectors and traders confirmed the earlier results. Seasonal calendars also provided information on relative supply and demand for fronds. A person can collect a big bundle of leaves in one day during the peak season, and a small bundle in the low season, with the price being relatively constant at N200 for a bundle in either season. Prices from each interview/diagram were cross-checked in a nearby frond market (Jajimaji village) and with people in Nguru. In Gwaiyo, one process chart was drawn by an older man who is actively involved in doum palm collection since the resource is not as important there. However, these figures were almost identical to those of Adiani.

[c] The returns to labour from weaving mats from doum palm fronds were estimated using the results of semistructured interviews with different groups of young, married and elderly women in Adiani. They reported spending about 4 hours a day for a week to weave an average N80 mat. There are no significant inputs required, aside from the fronds, which are worth about N30 per mat (during peak production season). The time required to make mats and the associated returns were cross-checked between the different groups interviewed. The prices of mats were cross-checked in Nguru.

Resource	Returns to Labour (1995) (Naira per day)[a]	(US$ per day)[a]
Potash (Adiani)[e]	26–31	0.33–0.39
Agricultural Wage Rate in Wetlands (planting, weeding)[f]	50–70	0.60–0.90

Descriptions of PRA techniques mentioned below—eg. pile of stones, matrix scoring, etc.—can be found in Appendix A.

For all the wild resources, the groups of villagers harvesting them were identified through a semi-structured interview with the village head and cross-checked with ward heads and informants from the groups in question.

The prevailing agricultural wage within villages is an interesting benchmark against which to compare the returns to labour. The wage paid for agricultural work will vary depending on the amount of effort required for the task and the abilities of the labourer. Nonetheless, informants from numerous villages and representing different groups consistently reported this rate as between N50 and N70 (US$ 0.60–0.90) for a 6–7 hour workday. Table 2 shows this amount, together with the estimated returns for harvesting and selling the three wild resources.

Harvesting doum palm fronds and selling the dried bundles yields a return of about N200 (US$2.50) per day. This is more than three times the average agricultural wage rate and is higher than the return of any other resource studied. These estimates were cross-checked with data collected by HNWCP on a weekly basis during 1994 in Margadu, a village near Adiani that sells its doum palm fronds to markets along the same road. In that study, the earnings per collector ranged from US$1.20 to US$2.80 per day with an average of US$2.15 per day. This indicates that, although the results of this study may be somewhat high, doum palm is currently a lucrative resource to harvest.

The returns to labour for frond harvesting are much higher than for producing mats (eg N10, US$0.13, per day), reflecting the different nature of these activities. Weaving of doum palm products requires much less physical effort and can be undertaken simultaneously with other tasks. Mat-making is therefore often undertaken by those who spend more time at home, such as mothers with young children, women in purdah, and elderly men, while many other people are involved in the collection and sale of fronds.

Although the level of frond trading appears to be lower in Gwaiyo, approximate returns to labour from harvesting fronds were also estimated to be N200 (US$2.50) per day. There are a number of possible explanations for this: doum palm is collected during the times of the year when harvesting and planting of crops takes place, as well as during the dry season. Thus, devoting time to frond harvesting may carry some added risk in terms of not paying as much attention to one's crops. Second, while anyone in the village can supposedly harvest doum palm fronds, it is unlikely that outsiders could collect doum palm from the village's fields without special permission. Doum palm may just be relatively scarce with the best (ie, young) trees for harvesting tending to be found on land over which villages can exercise a fair degree of control. A final explanation is that recent increases in demand for fronds, particularly for commercial uses, may be taking some time to result in others' finding ways to capture some of this economic rent. At the village level, for example, a strong system of patron-client relationships between collectors and

[d] The returns to labour from collecting firewood and carrying it to Gwaiyo were estimated with data obtained from a process chart drawn by a group of six or seven young men. Similar figures on carrying firewood were obtained from a series of semi-structured interviews held with about a dozen firewood vendors comprising both men and women.

[e] The data on potash collection were obtained from separate semi-structured interviews with three elderly women (in the company of a translator/chaperone) who collect potash in Adiani. Only about 30–50 women in Adiani engage in this activity. The women provided details on how much potash is collected during a year, how much time is required, how much it can be sold for and the necessary inputs.

[f] The agricultural wage rate reported by numerous informants was consistent throughout the Wetlands in both rural and urban areas. The N50–70 rate corresponds to an average day for a man during planting or weeding seasons, when labour tends to be in the greatest demand.

traders may preclude participation by just any member of the community. Thus, it is not possible to identify the real cause behind such high returns.

The returns to labour from harvesting firewood and carrying it back to Gwaiyo for sale were estimated at approximately N40–60 (US$0.50–0.75) per day. Carrying firewood is primarily undertaken by women while a number of men also transport firewood back to the village by donkey or ox-drawn cart. The returns from using these more effective means of transport are probably higher, reflecting the return on the capital items used for transport, but reliable estimates were not obtained. For many women, gathering firewood may be inseparable from agricultural work as many reported collecting the wood on the way back from their farms. By assessing labour input as effort, as opposed to simply time, the returns to labour for harvesting firewood would appear even higher in relation to agricultural work. This would be consistent with the claims by many women that firewood is an extremely important source of monetary income for them. In addition, numerous women have few other opportunities for earning cash income. On the other hand, a number of men reported undertaking firewood harvesting as a distinct activity occupying a large part of the day. Thus, the amount of individual's income derived from firewood will vary extensively but little more can be said without further information.

The returns to labour for women who collect and sell potash are estimated at N26–31 (US$0.33–0.39) per day, which is only one-half of the agricultural wage. This income is acquired with very modest effort and few external inputs. In addition, while the collection takes place during the dry season when there are fewer demands on people's time, potash yields a steady supply of income throughout the year. Potash therefore provides a relatively favourable return for some of the weakest people in the community—elderly women -who have few opportunities for earning cash. Although it is easy for anyone to start collecting potash, the low returns seem attractive only to old women. There may also be some social or cultural impediments to others participating in this activity.

Not surprisingly, there is a considerable difference in the returns generated by the various wild resources. Doum palm yields quite high returns to labour, at roughly three times the agricultural wage rate, and is clearly a lucrative resource to those involved in harvesting. Its currently elevated returns to labour may reflect a number of different factors such as greater risk, commercial relationships or market dynamics. Collecting firewood, an important source of income for women in Gwaiyo, yields returns that are slightly lower than the agricultural wage. But once the complementarity of firewood harvesting and agricultural work is also considered, the marginal return on effort is probably even greater in comparison to other activities. Lastly, potash yields even lower returns, but these are produced year round with minimal effort and benefit a group with fewer alternatives for income generation. These results demonstrate how it is not sufficient just to compare numbers to gain a better understanding of the role of wild resources in livelihoods. It is also necessary to examine a number of characteristics about the values generated (ie. by whom, when, with how much effort). Of course, it is also useful to examine the overall scale of the various activities, which is the focus of the next section.

Market Values

Information from a variety of sources, including previous studies, was combined to assess the gross market value of the wild resources harvested.[7] This was only possible for Adiani where estimates were obtained of the number of people involved in each activity.[8] The market value is the total amount of resource harvested, whether marketed or not, valued using market prices from markets along the edge of the Wetlands. The market value provides a rough indication of the importance of each resource to the local economy, in terms of its overall scale and in comparison to other activities. This calculation would be the first step in calculating the economic value (which cannot be done at this point due to the difficulties in assessing the opportunity cost of labour for various groups). In any case, market values are the type of

[7] It should be kept in mind that in arid and semi-arid environments subject to extreme variations in precipitation, annual averages for production carry much less meaning than in other environments. As the research component of this project was very short, it was not realistic to evaluate the extent of variation in amounts harvested from year to year. But at least the informants seemed to be comfortable with the concept of a `typical' year.

[8] See the notes to Table 3 for more explanation of how these results were obtained and cross-checked.

information sought by HNWCP as these figures, in which costs have not yet been netted out, are most useful in securing the attention of government officials.[9]

The estimated market values are provided in Table 3. Again, the estimated financial value of agricultural production is also provided for comparative purposes. In Adiani, this is N40 million. All of these figures are intended to be order of magnitude estimates that allow some comparison of the scale of each activity.

Table 3 Market Values of Wild Resources

Resource	Market Value in Adiani[a]	
	thousand Naira	thousand US$
Doum palm fronds[b]	8,800	110
Potash[c]	60.	0.75
Firewood[d]	850	11
Agriculture[e]	40,000	500

Descriptions of PRA techniques mentioned below—e.g. pile of stones, matrix scoring, etc.—can be found in Appendix A.

Estimates of the aggregate amount of harvesting for the various wild resources were calculated using information about the number of people engaging in each activity. This was revealed through a pile-of-stones discussion with a group of men and then cross-checked with village and ward heads, individual informants involved in other interviews/discussions, and in some cases, the research team's prior knowledge (for example, that nearly every woman in the region weaves mats). The number of people involved in harvesting particular resources was the means by which aggregate market values were estimated.

1994 for five villages in the Wetlands by HNWCP[10] and, if accurate, indicates that Adiani is a major frond selling and processing village.

[9] Of course, it would be inappropriate to use gross market values in a cost-benefit analysis without accounting for inputs and their costs. Regrettably, one first has to convince decision-makers in the relevant agencies that such an exercise is even worthwhile given the hidden nature of many of the benefits provided by the Wetlands and the relative `concreteness' of hydrological development projects. For this latter task, HNWCP has found `gross' figures to be more effective.

[a] Includes all production, both marketed and consumed in the village.

[b] The number of fronds harvested per year was estimated using the results of a scoring exercise by a group of men in the village (see above) and a seasonal calendar drawn by a separate group comprising both elders and younger men. The scoring exercise estimated the number of doum palm trader-collectors in Adiani at 150. The seasonal calendar and ensuing discussions revealed how doum palm collection varies throughout the year, including the number of bundles collected per week in both the peak and low seasons. These exercises, as well as other discussions, also provided data on the price of doum palm bundles in both peak and low seasons. The income generated by fronds was cross-checked with data collected on a weekly basis over the course of 1994 by HNWCP in a number of neighbouring villages and were found to be somewhat higher by about half an order of magnitude. Part of this can be explained by the fact that Adiani is a much larger village than those included in the HNWCP study and more importantly, by the fact that almost half of Adiani's harvest is estimated to be processed locally whereas the HNWCP estimates only cover marketed fronds.

[c] The quantities of potash collected per woman, the number of women engaged in potash harvesting and the price of potash were all obtained from a discussion with three elderly women who were all engaged in potash collection. The number of women collecting potash was cross-checked with the results of another discussion (see notes to Table 2).

[d] The market value of firewood collection in Adiani is based on data from Barbier *et al.* (1991) in which the quantities of firewood harvested in the whole Wetlands were estimated using an average figure for annual household consumption. The market price used in this earlier study was converted into US$ terms and then adjusted for inflation and changes in the exchange rate.

[e] A very rough estimate of the market value of agriculture for Adiani is included for comparative purposes. It was calculated using information from Barbier *et al.* (1991). The US$ estimate for agricultural production in 1989–90 was adjusted for inflation and the value of production in Adiani was calculated on the basis of the proportion of the Wetlands population residing in the village. This crude approach therefore ignores variations in agricultural production throughout the Wetlands.

[10] Not yet published.

Thus, doum palm appears to play quite a significant role in the local economy of villages which are close to the main marketing channels. The estimated financial benefits of frond harvests are almost an order of magnitude lower than those arising from agricultural activities. The high returns to labour for doum palm relative to agriculture however, indicate that if economic values for the two activities could be calculated, the gap between the two would narrow considerably. The relative importance of doum palm may then be even higher than is indicated by the market values.

Using information from secondary sources, the annual market value of firewood collection in Adiani is estimated at N850,000, another order of magnitude below doum palm. As this only represents subsistence consumption, the difference in comparison to doum palm is not very surprising. Adiani does not export significant quantities of firewood, although this does take place in other villages in the Wetlands.

Lastly, the value of potash production in Adiani is estimated at N60,000 per year which is another order of magnitude below that of firewood. As previously mentioned, potash collection is limited to a small group of women. The scale and importance of this activity clearly does not compare with doum palm or agriculture; nor does the scale of potash collection in Adiani compare with other sites around the Wetlands where significantly more potash is sold to traders for semi-industrial purposes. However, the importance of this activity to the collectors is quite high since they have few other income-earning opportunities.

As with the returns to labour estimates, the results highlight how wild resources can play very different roles in the local economy. Some resources generate attractive returns for a significant number of people who can engage in them, thus benefiting a large segment of the population. Others are far more modest in terms of the income they generate and how many people benefit. This diversity makes it difficult to generalise about all wild resources, in particular about how their economic role may shift with economic change. Such relationships must be examined on a resource-by-resource basis over a much longer time-frame. The results of this study would be very useful in designing such a long-term effort.

Changes in Resource Availability

A description of the values generated by resources at one point in time says little about their sustainability. It is helpful therefore, to ascertain whether any of the resources, particularly those with high values, appear to be declining in abundance, due to harvesting or other changes in their availability. In the Hadejia-Nguru Wetlands, decreases in the amount and extent of annual flooding could be reducing the supply of economically important resources.

In this study, changes in the availability and harvesting of resources over time were investigated primarily by means of historical matrices (see Appendix A) and the results are therefore more qualitative, involving relative changes. In the absence of archival records or other secondary sources, this is the only available means to assess initially the changing state of resources. In general, the historical matrices contrast the current situation with about a generation ago, as well as people's expectations for the next generation. Any indications of scarcity could provide the basis for considering a more in-depth study, including the use of biological sampling techniques.

The situation in each of the two study villages is quite different: recent hydrological changes have resulted in increased flooding patterns in the vicinity of Adiani, while in Gwaiyo people complain of a long-term decrease in the incidence and extent of flooding. The rich natural resources found in the Wetlands in general is, of course, directly related to the relative abundance of surface water in this semi-arid environment. Localised changes in flooding patterns are a normal occurrence in the Wetlands (Hollis *et al.* 1993) and it is difficult to know to what extent they relate to the long-term decline in the amount of water flowing into the Wetlands from upstream. In any event, the decline of many of Gwaiyo's resource systems demonstrates the nature of the impacts of a sustained decrease in flooding on local livelihoods.

In Adiani, the availability of doum palm and potash have both increased recently, as illustrated in the historical matrix in Figure 2. People in the village attribute this trend to the increased flooding, and in the case of doum palm, to recent planting by farmers to provide shade for crops and to mark the boundaries of their fields. In Gwaiyo, doum palm is not perceived to be under threat, despite the loss of flooding.

Taken together, it appears that even with the lucrative trade in fronds, doum palm is not being exploited on an unsustainable basis. In any case, there is a possibility of cultivating this species.

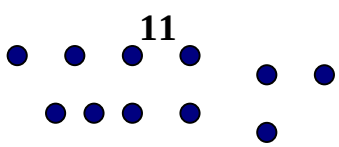
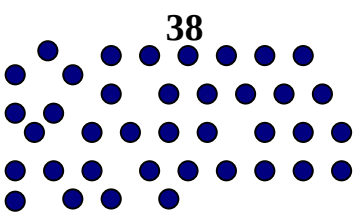
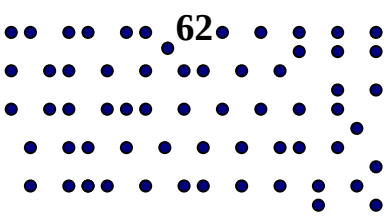
In Gwaiyo, many members of the community highlighted the decreasing availability of trees and their assorted products. This was attributed to three factors: increased harvesting (including felling) of trees for sale as commercial firewood by outsiders, increasing damage by nomadic Fulani herders[11], and decreases in flooding. It is not possible to establish at this point which factors are most important but almost all groups in the village place the most emphasis on the commercial firewood traders who bring in lorries with their own crews to collect firewood (including the felling of trees) for transport to urban centres. It is easy to understand the large impact this could have on the resource base, an issue which has been noted before (eg, ICRA 1992). During discussions with local forest guards, they admitted to problems in the system for licensing of firewood harvesters and complained of a lack of resources (vehicle and firearms) with which to monitor the nearby forest reserve properly.

Thus, it appears that a combination of factors is responsible for increasing scarcity of some resources in areas such as Gwaiyo. Increasing competition for scarcer resources among different groups from both within and outside the Wetlands is affecting the availability of tree-based resources, such as firewood and wild foods. Evidence gathered from this study supports earlier claims that current management of these resources, particularly in the forest reserves, is neither effective nor equitable.

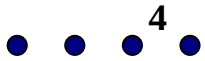
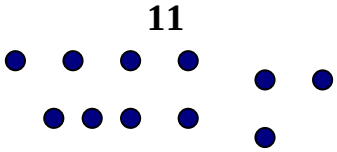
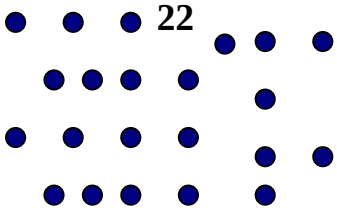
Figure 2 Historical Matrix of Doum Palm and Potash Abundance, Adiani

Drawn by a ward head and an elder, 19 July 1995

Doum Palm

past	present	Future
		

Potash

past	present	Future
		

[11] Unfortunately, the study teams were unable to arrange enough interviews with the semi-nomadic Fulani herders to ensure that their perspective was adequately represented. Previous studies have encountered similar difficulties which further heightens the need to include this important group in future research activities.

Conclusions

Economic Importance of Wild Resources in the Hadejia-Nguru Wetlands

The economies of both Adiani and Gwaiyo depend in large part on the wealth of wild resources available in the floodplain. The nature of the economic importance of these resources varies and the results of the study emphasise the difficulties in formulating generalisations on the economic importance of wild resources. Many activities based on the harvesting of wild resources provide important sources of income and the study succeeded in estimating returns to labour and market values of three resources.

Harvesting doum palm fronds generates returns to labour that are roughly two to three times the agricultural wage rate reflecting the current high demand for this product and the hard work or risk involved. This income is earned by a variety of groups (both men and women) within the communities generating market values which are smaller than that of agriculture by less than an order of magnitude. While the availability of many other resources in the Wetlands is decreasing, this is not the case for doum palm. This is due to its hardy nature and to the fact that cultivation has begun in some places.

Firewood also generates significant revenues for a range of individuals within Wetlands communities. People in Gwaiyo collect firewood from their nearby forest and there is an active market for firewood in the village. Men with access to capital items such as donkeys or oxdrawn carts earn considerable amounts by transporting large quantities of wood back to Gwaiyo for sale. At least half of this harvest is sold to small traders who transport the wood to larger towns. At the same time, a significant proportion of women in Gwaiyo carry wood on their heads to the village for sale (as do some men). This activity is particularly important for older women in Gwaiyo for whom there are few income-earning opportunities and who can combine this with farming work. Returns to labour are about 80 per cent of the agricultural wage rate. But the scale of this activity is much lower with market values in Wetlands villages estimated at about two orders of magnitude below agriculture.

The abundance of forest resources in the Wetlands has also attracted many outsiders who harvest and transport firewood out of the area to more distant urban centres. These operators are taking advantage of the lack of effective community or government control over some of the forest reserves in the Wetlands, including Gwaiyo's. Not surprisingly, local people emphasise the impact of outsiders on forest resources in the Wetlands. Competition for these valuable resources is also growing as a result of reduced flooding in many areas and increasing population density.

While doum palm and firewood generate income directly for a number of groups in communities in the Wetlands, potash provides an important source of income specifically for older and poorer women in areas where it is found. In Adiani, women earn about half the agricultural wage from devoting time to harvesting and selling potash within the community, an activity that requires modest effort and few tools. But the steady supply of income from selling potash throughout the year is one of their few opportunities for earning income. Similarly, the market value of this activity is quite modest: estimated at about three orders of magnitude below agriculture.

Thus, there is considerable difference in the returns to labour and market values associated with wild resources in the Wetlands. Some of these resources benefit a large segment of the population while others are more modest in terms of the income generated. The diversity makes it difficult to generalise about wild resources but provides valuable information for formulating more intensive studies of changing resource availability in the Wetlands. Forest resources, including both firewood and wild foods (fruits and leaves from trees and shrubs) is one area requiring both research and action, given the number of people involved, the scale of the current harvesting and the apparent decline in the resource base.

It is worth reiterating that the wealth of wild resources found in the Hadejia-Nguru Wetlands depends directly on the maintenance of annual flooding of the area. Indeed, in Gwaiyo, people explained how their general economic prosperity had declined as a result of reduced annual flooding in recent decades, affecting a number of economic activities including fishing, agriculture, livestock rearing, and harvesting of forest resources. The situation in Adiani is somewhat different as changes in the water courses in the Wetlands mean that recently, flooding has actually increased in the vicinity of the village, despite overall decreases in the Wetlands. Among other things, this has allowed women in Adiani to collect increased

amounts of potash. The contrasting experiences of the two villages indicates the degree of flood dependency of the local economy, including activities related to wild resource use.

Earlier reports have demonstrated that the economic returns to the floodplain as a production system appear much more favourable than existing and planned water developments along the river system which divert water from the Wetlands (Barbier, Adams and Kimmage, 1993). This assessment is based primarily on an estimate of the economic value of agriculture and fishing activities in the Wetlands, omitting, for data reasons, other important economic activities such as livestock rearing. The value of the hidden harvest strengthens this argument in favour of maintaining flooding levels in the Wetlands even though this value may not compare in scale as a source of income to fishing, agriculture or livestock rearing.[12] Wild resource production systems are an integral part of the Wetlands economy with linkages to other activities, such as fishing and agriculture, as a source of income for disadvantaged groups, and as source of goods and materials for the wider regional economy.

Methodological Issues

The second objective of the paper is to indicate how participatory research techniques can be used to investigate economic values associated with the utilisation of wild resources. Sections 3 and 5 demonstrate how the study used a variety of participatory research tools to investigate the economic value of wild resources in the Hadejia-Nguru Wetlands. Overall, the study was successful in understanding the economic importance of these and in identifying several specific use values, such as returns to labour and the market values of certain wild resources.[13] The study's success is three-fold. It first includes the insights and values presented in this paper. But it also encompasses the awareness of wild resource issues, raised with a diverse audience in Northern Nigeria, as well as the new experience gained in combining participatory research techniques with conventional analytical approaches.

An assessment of the participatory research using Lincoln and Guba's (1985) criteria of trustworthiness shows that it has been possible to ensure in broad terms the quality and integrity of the study (see Box 3). However, it was not possible to have confidence in all of the specific values which were derived from the study and these have been omitted from this paper. The authors believe that this can be attributed to the process of the study rather than an inherent contradiction in the use of participatory research for economic issues. This section summarises how participatory research methods were used to derive economic values and identifies two issues relevant for similar studies: the combination of training and research objectives and the transferability of the study findings.

Box 3 Research Assessment

The participatory research approach used here assured the **credibility** of its findings through establishing a good rapport with the two participating communities. This built on relationships and experience which the HNWCP has developed with various communities throughout the Hadejia-Nguru Wetlands since its inception in 1987. In addition, almost all members of the study team had some experience and about half the team had considerable experience of working with the communities of the Wetlands which greatly facilitated the rapid establishment of rapport with the study communities. However, as very few members of the team had experience of participatory research at the start of the study, the confidence of the team to be critical was limited at the beginning as their major focus was learning new research skills. (Table 1 illustrates the reliance of participatory research on constant, ongoing analysis.)

Conventional research uses random sampling from a defined population to enable the findings to be scaled up and applied to the whole population. The Hidden Harvest study used participatory research techniques in two, purposively selected and differing communities. It is not expected that the findings from

[12] Although it should be noted that a major group of wild resources, animals and birds, were not examined in this study and may also entail significant economic values.

[13] These estimates were obviously restricted to use values, and did not address non-use values. One previous Hidden Harvest study (Hot Springs Working Group 1995) has looked at non-use values and certain PRA techniques, such as contingent ranking, appear promising for assessing the relative importance of these benefits (such as cultural or bequest values; see Campbell *et al*. 1991). There may also be potential for exploring local concepts of use value, as opposed to neoclassical, or foreign concepts, using PRA techniques.

the two villages will be **transferable**, in their entirety, to communities throughout the Hadejia-Nguru Wetlands. However, since understanding the context of wild resource use in each village was an important part of the initial appraisal, it is possible to apply some of the lessons from the study to other communities in the Wetlands. For example, the value of potash collection in Adiani could provide a useful insight into potash collection in villages which have similarly seasonal and dispersed potash `patches'. However, the findings are not applicable to all oases in the region, some of which yield enough potash to fill a truck destined for the market in Gashua.

Conventionally, research is replicated and its reliability is proved or otherwise. The Hidden Harvest study used previously untried, and thus unreplicated, research techniques with the two study communities over the course of three weeks. The **dependability** of the study findings has been assured through `triangulating' particular issues with different socio-economic groups in each community. These were selected from the lists derived from wealth ranking exercises in each community. Dependability was also ensured through the use of a variety of research tools. Tables 2 and 3 explain how this was done for the results presented there; similarly, a comparison of participatory maps of wild resources with transects undertaken using direct observation illustrate consensus in the importance of various wild resources (see Figures A.4 and A.5). Dependability has also been ensured through comparison with information derived from earlier surveys of resource usage (see below). Where the findings of different research techniques were not comparable, these have been omitted as in the case of the wild foods.

Conventionally, researchers aim to eliminate the influence of the researcher on the process and results of the research method. The **confirmability** of participatory research depends on the presentation of sufficient information for a disinterested reader to confirm that the findings are not a figment of the research team's imagination. This again requires cross-checking with multiple sources of information. The values revealed by the Hidden Harvest study have been compared with a range of previous research: as explained above, doum palm earnings have been found to be comparable to those measured by the HNWCP during a monitoring exercise; returns from wild resource harvesting have been compared with those derived for fishing in the Wetlands and found to be of similar order of magnitude (fishers earned approximately twice that of doum palm collectors, which reflects the greater personal and storage risks involved and higher levels of working capital [see TMAF, 1995]); and the economic importance of a range of natural resource production has been compared with Barbier *et al*. (1991). However, as the rationale underlying the study is that little is known of the value of the Hidden Harvest in the Wetlands, comprehensive cross-checking of all the study's findings is not feasible, leaving open the possibility of future revision to the current results.

Economic Values and Participatory Research

There are two dimensions to economic value: a *qualitative* one which provides an understanding of the importance of wild resources to the productive and reproductive activities of different groups within a community at different stages of their lives and in different seasons; and one which provides *quantitative* summaries of key aspects of these activities. This study has sought and revealed both dimensions and, in contrast to the commonly perceived trade-off between `participatory but qualitative' and `conventional and quantitative' research methods, this study found that it was possible to include participatory findings in conventional analyses. While the qualitative understanding which participatory research techniques can provide for a range of issues is now relatively well-known, its use to derive quantitative values is less appreciated and therefore summarised here.

The concept of relative values underlies many of participatory research tools. For example, seasonal calendars were used to investigate fluctuations in the demand and supply of wild resources and the opportunity costs of household resources at different times of year; wealth ranking was used to provide a socio-economic stratification of the study communities; and pie charts were used to examine sources of income and food. The relative values and the limited absolute values revealed by the research were utilised in conventional methods of analysis to estimate absolute, quantitative values from the participatory research findings. Tables 2 and 3 are examples of how information gathered from the participatory research has been used to derive values for returns to labour spent on harvesting and processing three wild resources and to estimate their market values.

However, success in quantifying these values was varied. Whereas there was a high level of confidence in the values estimated for doum palm harvesting and processing, the results obtained for the variety of wild foods which were investigated were not as convincing. This is attributed to the large variety of wild foods that are exploited and the broad range of information that was gathered. The more robust doum palm findings reflect the clearer focus of the study team on this resource and highlights.

Training and research

The training component of the study necessitated a balance between the study's dual objectives of research and training, a major challenge faced by the project as implied in the preceding discussion. The use of participatory research tools were the focus of the workshop's training component. As achieving the training objective required a fair amount of learning-by-doing, a certain level of error was helpful to the learning process. The research objective, however, required a balance between the benefits of learning from mistakes and the research imperative to undertake the highest quality investigation possible within the time constraints of the study.

The experience of undertaking participatory research in this training exercise has shown that it is possible to use participatory methods to elucidate economic values, both qualitative and quantitative. The workshop highlighted the fact that confidence in such values depends on the ability of the research team to be critical of their findings, which in turn relies on their experience and familiarity with participatory methods. Furthermore, the research team must be able to undertake rapid, on-the-spot analysis of findings. The ability to do this relies on their general research experience and basic knowledge of the topic and related issues. The authors as the trainers believe that the research team's collective self-confidence is paramount although difficult to achieve in the course of short training workshop.

Two, less ambitious training options emerged from the study. These include devoting more resources to such a study or focusing existing resources on a smaller number of more experienced researchers. The balance of experience amongst the members of the study team was towards extension rather than research. If they had been learning about participatory research only, rather than basic economics and basic research skills, they would have been able to make better and quicker judgements of research issues. A second option is to devote more time to training first, and then conduct research rather than attempting both objectives simultaneously.

Transferability of study findings

One rationale for using participatory research is so that informants can participate as stakeholders in the analysis, yet there is an inherent conflict of `philosophies' between conventional analyses and participatory approaches. This is particularly relevant to the validity of results which are scaled-up and applied to a wider population. The aggregation of economic values across the entire Wetlands was not attempted and the transferability of these findings is limited to communities in similar circumstances to the two study communities.

Scaling-up, however, is an area where the insights and illustrative values revealed through participatory research can act as a powerful complement to a sample survey both technically and practically. Technically, participatory research can provide a theoretical model or basis for more conventional research; secondly, it is possible that the level of variation revealed in the participatory studies could help determine the necessary size of a possible sample survey. Practically, the rapport which participatory research encourages with the study communities offers a good starting point for any interactions between communities and outsiders, and can assure in some part the credibility of the information gathered from them.

Summary

Participatory research methods were used successfully: they were understood and used enthusiastically by a team of professionals working with wild resources in the area; they promoted a high level of participation by the two village communities in the research; and as a result generated useful and relevant information on the economic value of wild resources in the Hadejia-Nguru Wetlands. Caveats, however, apply to the latter of these conclusions.

Both the planning and the analysis of the research have involved more participatory learning than participatory action by the two communities. The questions which guided the research with Adiani and Gwaiyo were identified by the study team without community involvement. However, the high level of community participation in the research indicates the relevance of the research questions, and when the two communities have access to the research report and are able to react to its findings, the analysis will have become less `extractive' and more `facilitative'.

The study confirmed that participatory research techniques can be used to investigate both relative and absolute economic values, although, there are limitations to the use of collecting absolute quantities for aggregation and scaling up over a wide area. Nonetheless, increased understanding of the economic importance of wild resources provides useful and timely information with which the HNWCP will be able to reinforce its important policy recommendations on the necessity of maintaining regular flooding of the Wetlands.

Appendix A Participatory Research Techniques

Participatory research uses a basket of `tools' or methods that is constantly being refined and supplemented as practitioners find more effective and interesting ways to generate information. Participatory research techniques involve local people not only as sources of information but also in analysis, planning and dissemination (Mettrick, 1993). Many of the tools are based on one or more of three basic participatory research techniques. These are semi-structured interviewing, diagramming and ranking, none of which are exclusive categories or have fixed boundaries (Box A.1).

Box A.1 Participatory research techniques

Semi-structured interviewing

SSI is often regarded as the `workhorse' of PRA because it is used both on its own and as part of the other tools which require teams to ask questions and probe issues in a sensitive way. Along with a review of secondary sources, SSI is the only tool which is used in every PRA. (Schoonmaker-Freudenberger and Guèye, 1990)

Instead of formal, prepared questions, SSI uses a “checklist” to guide the interviewers through the topics they which to address. It takes place in informal sessions where only some of the questions are predetermined and new questions or lines of enquiry arise during the interview in response to answers that have been given. Interviews may be specially arranged and interviewees selected on the basis of a particular characteristic of their farm, household or enterprise. Alternatively, the team may interview individuals whom they meet by chance during their visits to the area. Interviews with key informants can yield specialist information and group interviews can explore and analyse an issue confronted jointly by the group.

Diagrams

Another key PRA technique is the use of conceptual and diagrammatic models. These are simple schematic devices which present information in a readily understandable visual form. Their usefulness is two fold: the act of constructing the diagrams is in itself an analytical procedure which helps the constructors to think through the dynamics they are trying to put down; and second, the diagrams become a means of creating communication and discussion between researchers and community members. There are many types of diagrams including maps and transects.

Ranking

The importance of ranking tools lies in the fact that there is often no need to have absolute values for certain information eg, peoples' income. Informants may be reluctant to share such information or unable to recall it. For many purposes relative rankings are just as useful and less sensitive and demanding on the respondent's ability to remember with accuracy. Preference ranking asks communities to prioritise their preferences or concerns for various items or issues.

The Hidden Harvest study of the Hadejia-Nguru Wetlands used a range of participatory research tools based on these techniques to investigate wild resource use in two communities over the course of three

weeks. The study focused first on training and clarifying the research objectives. An initial appraisal was then conducted with each community over the course of four days. This provided a general picture of the wild resources utilised and the basis for the subsequent focused appraisal which concentrated on four wild resources using a range of participatory research tools. Each of the tools used during the detailed appraisal is briefly explained below while Table A.1 shows which tools were used to investigate various issues in the research process. Two additional tools, walking transects and resource maps, are illustrated in Figures A.4 and A.5. These are referred to in the last section of the paper. (For interpreting some of the diagrams, a glossary of local terms for various resources is provided in Appendix C).

Table A.1 Research Questions and Research Techniques

Research Questions	Research Techniques
What are the resources? Where are they? What is their relative abundance?	Participatory mapping, transect walks, existing knowledge of the research team,
Which resources are important to which groups in the community?	Transect walks, wealth ranking, semi-structured interviews
What are the resources used for?	Semi-structured interviews, process charts
What is the process chain of the resource? Is it processed? Is it consumed locally? Is it traded? Who is involved?	Process charts, semi-structured interview, existing knowledge of the research team
How is the utilisation of the resource controlled? Who maintains authority over the resource? Who has access to the resource?	Semi-structured interviews, secondary information
What is the seasonality of harvest and use?	Seasonal calendars, existing knowledge of research team, secondary information
What is the economic importance of the resource? What is its market value? What other economic roles does it have?	Market survey, investigations of costs and earnings, pie charts using the pile-of-stones technique, seasonal calendars, semi-structured interviews
What are the other values of the resource?	Semi-structured interviews, existing knowledge of research team
How and why is resource use changing?	Historical matrices, semi-structured interviews, timelines, existing knowledge of the research team.

Note: Most but not all of the research techniques are PRA techniques. Some conventional techniques were also used (eg. market survey).

Participatory Research Tool: Wealth Ranking

Wealth ranking provides a socio-economic profile of a village. The wealth ranking exercise uses community members' own definitions of wealth. Therefore, a preliminary step in the ranking process is an interview with the informant to determine what wealth means to him or her. One objective is to acquire a list of the households in the village ranked or grouped in order of their relative wealth status or well-being. In the process of obtaining this list, a further objective is to gain insights into the criteria attached to well-being or wealth and what differentiates households from each other. This can also provide important keys to how local resources are valued and managed. The information generated by wealth ranking is also helpful in the subsequent selection of informants in such a way as to offset the bias inherent in different perspectives. Thus once the team has an idea of the relative wealth of various people in a community, it can make a point of including people from all groups in the interview schedule. The wealth ranking

conducted in this study provided the basis for investigating potential differences in wild resource use between different socio-economic groups in the communities.

Participatory Research Tool: Seasonal Calendars

Calendars help to understand changes in livelihood strategies over the course of a year. The first objective of a seasonal calendar is to build up a visual pattern of activities throughout the year and thus enable a group discussion based on a diagram that all can see, understand and amend if necessary.

The simplest calendars are those which simply show what is happening at any point in time. An example is a calendar which shows the time when different wild foods are harvested. Other calendars show not only what is happening, but also give an idea of the intensity or importance of the activities. This study used such calendars to investigate seasonal variations in the quantities of wild resources harvested and in their prices. The communities involved in the study used fruit stones to illustrate relative rather than absolute values for these variations (see Figure A.1).

Participatory Research Tool: Pile of Stones/pie charts

This tool is useful in illustrating the sources or destinations of the various portions of a total amount. A pile of stones can be used to represent the total amount which can be divided up by the informants into relative proportions. For example, the total harvest can be represented by the whole pile of stones and the proportions consumed at home, processed and stored, or sold can be demonstrated by dividing the pile into relevant smaller piles. This process provides a basis for both individual and group discussions where debate over the relative size of each pile can reveal interesting insights into decision making. This study used pie charts to investigate both sources of income and expenditure as well as the end use of resources.

Participatory Research Tool: Process Charts

Process charts help break down and analyse important activities. They can illustrate all the inputs to and outputs from an economic activity, who is involved and the alternative ways of doing it. A discussion group is asked to list the key steps involved in a particular activity. Each step is represented symbolically or pictorially and acts as a focus for the discussion on inputs and outputs. Inputs and outputs can be linked diagramatically to each step in the process. Respondents can use the resulting process chart to explain features of their activities which they might otherwise take for granted and not reveal to outsiders. The study employed process charts to examine the steps from harvest through to the sale of each of the wild resources considered in the focused appraisal (see Figure A.2).

Participatory Research Tool: Matrix Ranking

Matrix ranking can be used to investigate the various values which a group attaches to particular resources. It can reveal both use and non-use values and their relative importance. Matrix ranking involves asking an informant or group of informants about the good or bad qualities of various items (eg,. tree species) revealing the various qualities or criteria which they think are important. The items being discussed and the criteria for judging them can then be put quickly into a matrix or table and the informant can rank the item according to each criteria. Matrix scoring was used to investigate the variety of qualities associated with different wild resources in the Hadejia-Nguru Wetlands (see the example in Figure A.3). Changes in the availability of resources over time were investigated with historical matrices (see Figure 2).

Figure A.1 Seasonal Calendar of Doum Palm Products, Quantities and Prices

Drawn following discussions and analysis with two elders and a group of 5 young men, Adiani, July 17th and 18th 1995

	Damuna	Kaka	Rani	Bazara
Doum Palm products	Gucci leaves fresh goruba	Goruba leaves (alot)	Ganga Wood	Fresh gucci, root, wood and leaves

	Damuna	Kaka	Rani	Bazara
Fronds prices	3	8	7	5

	Damuna	Kaka	Rani	Bazara
Fronds quantities	3	5	8	7

Figure A.2 Process Chart for Firewood Collection

Redrawn from a diagram by a group of male youths, Gwaiyo, July 15th 1995

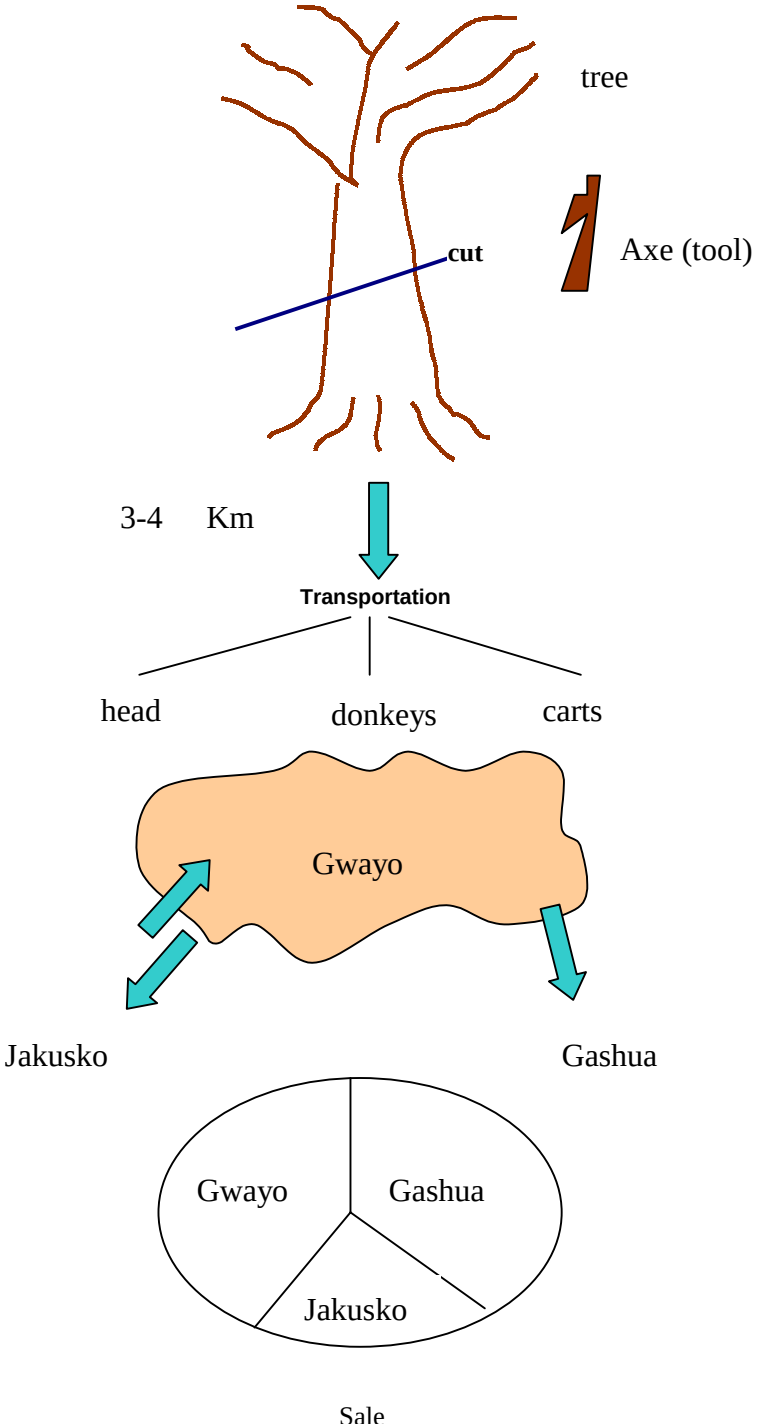


Figure A.3 Matrix Scoring of Wild Resources and their Uses

Redrawn from a diagram by male youths, Gwaiyo, 10 July 1995

	Fishing	Gum arabic collection	Doum palm	fruits	Firewood
Income	9	2	4	2	3
food	8	2	4	2	4
construction		3	7		10
medicinal	1	4	3	3	9

Figure A.4 Transect Walk, Adiani Village

Drawn from discussions and a walk with an elderly and a young man, July 7th 1995

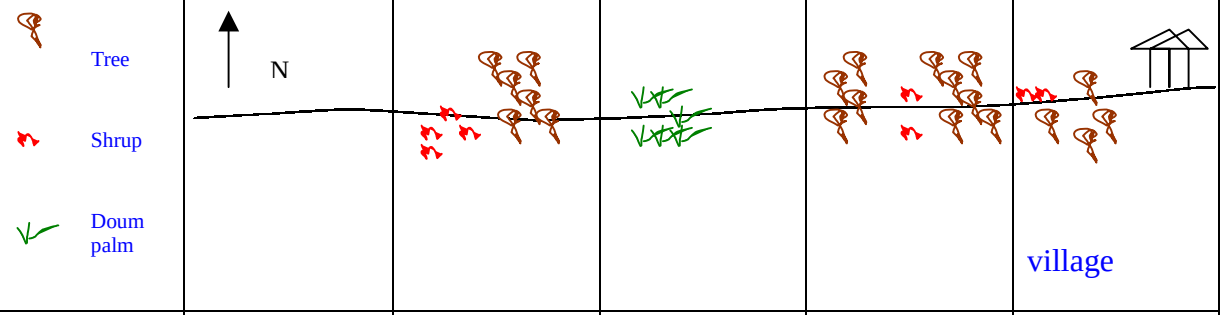
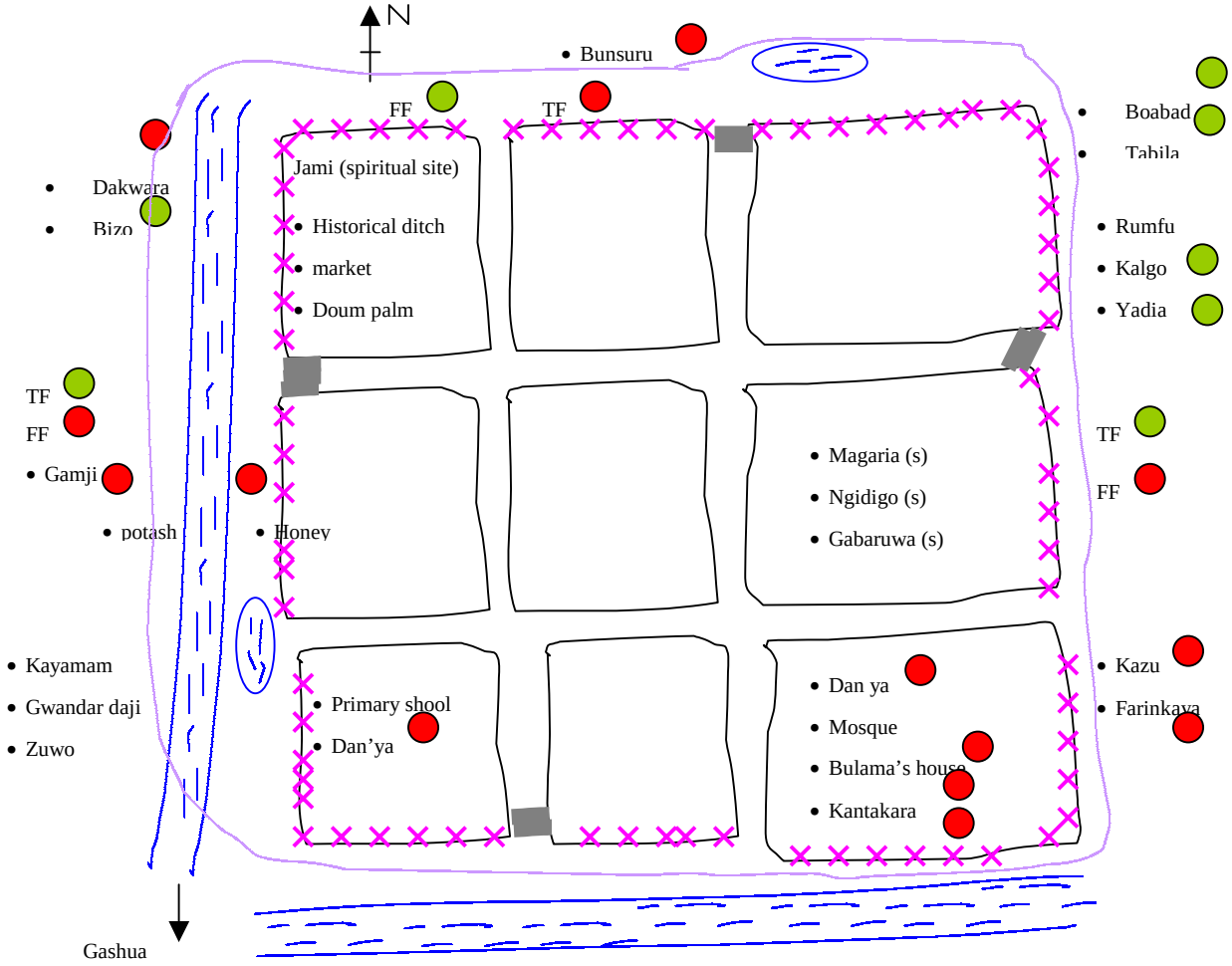
					
Land use	Forest	Irrigated orchard, irrigated vegetable farms	Forest	Orchard, forest	Forest reserve, farmland, doum palm plantation, settlement
Soil and land type	Sandy loam fadama	Sandy loam fadama	Sandy loam flood plain	Sandy loam	Sandy loam
Vegetation type	Dense savanna	Dense savanna	Sparse savanna	Dense savanna	Dense savanna
Tenure	Communal	Individual	Communal	Individual (orchard) Communal (forest)	Individual (farmland), Communal (forest)
Resources	Wild trees (eg kuka, adua, doum palm) and wild grasses (eg yadia.) Some cultivated crops.	Cultivated vegetables, maize, rice. Some wild trees (eg magariya)	Wild trees and shrubs (eg kuka, doum palm)	Cultivated fruit trees (eg mango, guava), wild trees (eg adua, doum palm)	Wild trees (eg doum palm, dinya, kuka, tsamia,), wild grasses (eg bahama), honey and some cultivated crops

Figure A.5 Village Resource Map, Adiani

Redrawn from the *Bulama* and elders' map, July 8th 1995



Key

- Vegetal Resources
- Plenty
- Pond
- River
- Small
- Street
- village boundary
- Ancient gate
- Ancient wall
- FF — Fadama farmland
- TF — Tudu farmland

Appendix B: Participants in the IIED-HNWCP Hidden Harvest Workshop

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Appendix C: Glossary of Botanical Terms

Hausa Name	Botanical Name
Aduwa	*Balanites aegyptiaca*
Aleeho	*Amaranthus*
Anjiri, Hojeri	*Capparis tomentosa; Capparis decidua*
Bagaruwa; Gabaruwa	*Acacia nilotica*
Bagayi	*Cadaba farinosa, Capparis corymbosa*
Baure	*Ficus gnaphalocarpa*
Dabino	*Phoenix dactylifera*
Dakwara	*Acacia senegal; Acacia laeta*
Danya	*Sclerocarya birrea*
Dargaza	*Grewia bicolor*
Dashi	*Commiphora africana*
Dinya	*Vitex domana*
Dirga; Jirga; Shishi	*Bauhima rufescens*
Dorowa	*Parkia biglobosa; Parkia clappertoniana*
Dundu	*Dichrostachys cinerea*
Farin kaya	*Acacia seyal*
Farin bagaruwa	*Acacia sieberiana*
Gamba Grass	*Andropogon gayanus*
Gamji	*Ficus platyphylla*

Hausa Name	Botanical Name
Gaasia	*Gynandropsis gynandra*
Gawo	*Acacia albida (Faidherbia albida)*
Giyayya	*Mitragyna inermis*
Goruba	*Hyphaene thebaica* (Doum palm)
Gwandar daji	*Annona senegalensis*
Jiji	*Cyperus sp*
Kaba	*Hyphaene thebaica* fronds
Kalgo; Kargo	*Piliostigma reticulatum*
Kalumbo; Namijin yaadia	*Leptadenia pyrotechnica*
Kandili	*Acacia tortilis*
Kanya	*Diospyros mespiliformis*
Kari	*Hyphaene thebaica* root
Karya	*Adenium obesum*
Kasari; Gatsari	*Albizia chevalieri*
Kantakara	*Combretum glutinosum*
Kiriya	*Prosopis africana*
Kubewa	*Hibiscus esculentus*
Kuka	*Adansonia digitata*
Kukuki	*Sterculia setigera*
Lulu danya	*Spondias monbin*
Madachi	*Khaya senegalensis*
Magarian kura	*Ziziphus mucronata*
Magariya	*Ziziphus mauritiana*
Marike	*Anogeissus leiocarpus*
Ngidido	*Crateva adansonii*
Rimi	*Ceiba pentandra*
Runfu	*Cassia singueana*
Sabara; Shabara	*Guirea senegalensis*
Sarkakya	*Acacia ataxacantha*
Tabila, Bultu, Anza	*Boscia senegalensis*
Tafasa	*Cassia tora*
Taramnya	*Combretum sp*.
Tsada; Saada; Dandum (K^1)	*Ximenia americana*
Tsamiya	*Tamanrindus indica*
Tumfafia	*Calotropis procera*

Hausa Name	Botanical Name
Yaadia	*Leptadenia hastata (Leptadania lancifolia)*
Yaakuwa	*Hibiscus sabdariffa*
Zogalla gandi	*Moringa oleifera*
Zuwo	*Celtis integrifolia*

1. K = Kanuri

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