

The Contribution of Pine Forests to the Living Standard in Farming Systems in the Zerhouné Mountains, Central Morocco

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1 Introduction

With a share of about 7.3% of its territory, Morocco, including the former Spanish West-Sahara, possesses the largest forest area of all North African countries (CORTAS et al., 1988). This however is still low in comparison with the world average of 29% (KARMOUNI, 1988). Reafforestation efforts by the National Moroccan Forestry Service supported by the World Bank and the FAO have to cope with annual losses of forest areas that are currently about equal to the reafforested area per year and are expected to double due to population growth by the year 2000 (BERRADA, 1988). The estimated national wood production of 3 million m³ per year stands against an estimated consumption of 10 million m³, whereby fuelwood is the main product from trees (TOUHAMI, 1986). In 1989, the quantity of traded wood was up to only about 2.1 million m³ (FAO, 1990). This emphasizes, that forest utilization by the local population is a major reason for deforestation.

Forestry in Morocco is a nearly exclusive domain of the National Forestry Service. Agro-forestry by farmers is sparse. Probable reasons are the history of forest legislation and the current right to say of the Service. Revenues of timber sales from forests on communal land are awarded to the communities' budget but the resulting indirect benefits are difficult to recognize on the community members' level. For the local families, felling of trees is prohibited and the local forestry services fix maximum rates for livestock on forest pasture, pasture-free periods and areas. However, violations are a common problem (HAFFANE, 1988). Local families decide on their forest utilization according to their individual needs and objectives. From their point of view, forests are a communal resource for making up their livelihood and forest utilization is a subsystem like cropping or livestock husbandry (POSCHEN-EICHE, 1987). Consequently, successful afforestation or protection of existing forests is impossible, if the local population's interests are neglected.

A comprehensive analysis of the role of forests has to consider all families in the rural community. Hence, the term farming systems is somewhat misleading since also fami-

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lies that make their living from non-agricultural activities, such as trade or crafting, may collect wood or have some animals on forest pasture. Nevertheless this term will be used since the decision-orientated farming systems approach as defined by Doppler (1993) already puts the families' behavior at the centre of reflections instead of interactions between activities. Consequently, it does not matter if the internal conditions of families include a farm component or not. This enhanced interpretation of farming systems has the advantage of sticking to an already defined philosophy and avoids confusion due to a new term at the current state of discussion.

2 Materials and Methods

A field survey, based on a double-stage random sampling design and using standardized questionnaires, was conducted in a rural community near the city of Meknès in 1990. The chosen community has a total area of 179 km² and possesses about 2,000 ha of forests, which consist mainly of Aleppo pine stands in an age of 35 to 45 years and an average stand density of 261 trees/ha. The estimated 17,000 members of the community live in 2,906 households divided between 20 villages.

Capacity restrictions for data collection determined the sample sizes at both stages of the survey. Sampling errors were considered by calculating confidence limits of estimates considering a probability of 90% (cl_{90}). The first stage of the survey followed a stratified sampling plan, whereby the villages of the community served as strata and 5 to 6 randomly chosen households, altogether 118 households, were interviewed. This interview concerned data on farm and household capacities, consumption and supply of energy and wood, sylvopastoral activities and other utilization of communal forest areas. The questionnaire of the first interview was developed on information from a preceding informal survey.

A multivariate classification by cluster analysis, using 13 quantitative characteristics about realized and potential forest utilization, led to a distinction of three farming systems classes. These classes served as strata for the second stage of the survey. The 44 interviews were proportionally divided according to the estimated share of each class in the total population. Subject to this interview were items relevant for estimating income, liquidity and household supply as well as opinions about forest utilization. Also information was collected on results of activities in good, worse and average years in order to interpret results in the dynamic context. Empirical estimations of farmers' and families' reaction to variations, which would require multi-period data collection, were replaced by deterministic assumptions.

The somewhat complex calculations of estimates and confidence intervals due to the applied sampling design were solved by programming in dBASE. Literature and data from comparable sites served for estimations of tree growth, litterfall production and fodder growth in the communities' forests.

3 Results and Discussion

The population in the study area used forests by sylvopastoralism, combustible and herb collection. Sending livestock on forest pasture required registration and cost fees depending on the number and species of animals. The regional forest service restricted grazing in forests to a period of 6 to 7 month after the first rain in autumn and prohibited sylvopastoralism in the dry season due to fire hazard.

Authorized collection of combustibles included dead branches, undergrowth and cones. Survey results showed that wood for construction and handcrafting comes from other sources, such as olive trees in ownership and purchase. Employment in forestry played a negligible role due to the current extensive forest management.

3.1 Classes of farming systems with regard to forest utilization

The three farming systems classes were significantly different (confidence level of at least 90%) with regard to the intensity of forest utilization, family size and age structure, production capacities and combustible purchase. Results of the second survey substantiated the classification by significant differences regarding parameters of income, liquidity, household supply and risk. Except for some villages that were located approximately one hours walk away from forest sites, distance between households and forests played a subordinate role for forest utilization.

Table 1: Significantly¹ different characteristics of farming systems with regard to forest utilization (estimates for means and confidence limits at a probability level of 90%, Rural community of M'Ghassyine, Central Morocco, 1989/90)

	class 1	class 2	class 3
n (first survey)	38	24	56
estimated proportion of the total population (%)	30.1 (± 7.5)	27.4 (± 7.8)	42.5 (± 9.0)
fuelwood collectors (%)	100 (± 1.3)	10.3 (± 2.1)	13.9 (± 8.9)
sylvopastoralists (%)	13.7 (± 6.6)	11.9 (± 2.1)	4.5 (± 0.9)
herb collectors (%)	54.6 (± 15.9)	16.9 (± 2.1)	23.6 (± 2.1)
only fuelwood collectors: annual quantity of fuelwood from forests (kg/family)	1,451 (± 218)	233 (n.c.)	426 (n.c.)
only sylvopastoralists: livestock on forest pasture (heads)	21.1 (± 37.8)	6.3 (n.c.)	16.3 (n.c.)
annual cash expenses for combustibles (DH/family)	522 (± 101)	1,577 (± 48)	725 (± 126)
family members (number)	6.1 (± 2.8)	8.6 (± 0.64)	9.3 (± 0.21)
annual labour capacity for off-household activities (man-days/family)	745 (± 135)	1302 (± 246)	1245 (± 185)

¹ Significance of differences tested by the Kruskal-Wallis test regarding all 3 classes and by the Mann-Whitney test regarding class 1 and 2 at a confidence level of 90%
n.c. not calculable due to sample size = 1 in at least 1 strata

Members of class 1 used the forest most intensively with regard to the proportion of forest users as well as in terms of quantity (Table 1). They also kept significantly more animals in commission and spent least on combustible purchase. The number of household members and labour capacity was lowest of all 3 classes. With regard to labour demand, labour capacity was no limiting factor in all classes.

For families of class 2, fuelwood collection played a negligible role, but frequency of sylvopastoralists was about the same as in class 1. Their production capacities, possession and living standard were highest of all classes. Indicators from the first survey were the highest frequency of land title holders and the highest expenses for combustibles. Even if the number of family members was lower than in families of class 3, labour capacity was highest due to the large proportion of members in an age of 15 to 60 years in case of women and 15 to 65 years in case of male family members.

Except for herb collection, forests played no role as a resource for the dominant part of families from class 3. In comparison to the other two classes, living standard of these families was lowest. Data from the first survey indicated, that they had to satisfy the needs of larger families by production capacities and possessions that were comparable to those of families from class 1. Their expenses for combustibles were significantly higher than in households of class 1. This indicated that those families were excluded from forest utilization due to external conditions, such as their social position in the community and the distance to forests, rather than due to own decisions resulting from internal capacity constraints.

Table 2: Characteristics of economic success in farming systems (estimates for means and confidence limits at a probability level of 90%, Rural community of M'Ghassyine, Central Morocco, 1989/90)

	class 1	class 2	class 3
n (second survey)	15	9	20
family income (DH/year)¹	19,080 (± 7,391)	51,902 (± 21,464)	17,998 (± 2,941)
family income per household member (DH/year)¹²	3,483 (± 1,118)	6,194 (± 2,226)	2,150 (± 416)
cash outflows for household purposes (incl. combustibles, DH/year)¹	10,336 (± 2,627)	17,317 (± 4,188)	11,133 (± 2,223)
cash outflows for farm purposes (DH/year)	5,220 (± 2,111)	10,474 (± 9,145)	2,930 (± 963)
Total cash outflows (DH/year)¹	15,556 (± 4,107)	27,791 (± 12,182)	14,063 (± 2,497)
Total cash inflows (DH/year)¹	14,331 (± 4,411)	39,574 (± 27,977)	11,935 (± 3,434)

¹ Significant differences according to the Kruskal-Wallis test regarding all 3 classes ($\alpha = 0.1$)

² Significant differences according to the Mann-Whitney test regarding class 1 and 3 ($\alpha = 0.1$)

Source: compiled from Wolff (1995)

3.2 *Living standard in the farming systems classes*

The potential living standard of families depends on their income (DOPPLER, 1985). Additional analysis of liquidity is required since income includes also production for home-consumption and increase in value of capital. Consequently, income expresses nothing about the availability of cash, which is required, for example, for purchase of substitutes for products from forests. The third parameter of analysis was the family supply as criterion for the real living standard.

As expected from the classification results, family income, that is to say the total of farm and off-farm income, was highest in farming systems of class 2. Family income in the both other classes were not significantly different but income per member of families in class 1 was about one third higher due to the smaller family size (Table 2).

Fuelwood collection in forests contributed in average about 2.4% to incomes in class 1. Linear correlation between the quantity of collected fuelwood and farm income was positive but correlation with off-farm income was negative. This indicates, that higher cash incomes lead to a replacement of fuelwood collection by purchase of energy, even if the correlation was not significant. Concurrence for labour as an alternative explanation was unlikely due to the stated surplus of labour capacity in all classes and the shelf-life of fuelwood, which allows collection in periods of low labour demand. For the other farming systems classes, creation of income by fuelwood collection in forests was negligible (with in average less than 0.1%).

Sylvopastoralism had an impact on income due to the larger herd size of livestock holders but did not increase outputs of individual animals. Also, the period for grazing in forest played a more important role than their contribution to the annual fodder demand of livestock. The communal forest pastures had a potential to cover only about 5 to 7% of the annual energy demand of the total herd in forests, even under optimistic assumptions. The importance of access to forests is derived from the coincidence of the availability of forest pastures with the vegetation period, when cultivated areas are excluded from grazing. However, the available data allowed no unambiguous distinction between cause and result. This concerned the question if access to forest pasture allowed the keeping of more livestock or if a certain herd size forced farmers to send livestock to forest pasture as well as the question, if sylvopastoralism led to higher incomes or if having higher incomes allowed the payment of more fees for livestock on forest pasture.

Quality of estimates regarding liquidity suffered from high variances particularly with regard to cash inflows (Table 2). Accordingly, figures have to be interpreted with care. Results indicate that families from class 1 and 3 suffer from liquidity bottlenecks, which prevent substitution of products from forests by purchase. Outflows for household energy were significantly higher in families of class 2. Households of class 3 had to spend in average about 50% more for combustibles than those from class 1. The about equal outflows for spices and medicine in households of class 1 and 3 indicated, that herb collection from forests played a relatively negligible role.

In addition to income and liquidity, living standards in families of class 2 were significantly higher. This was expressed in detail by the consumption of vegetables, eggs, milk, spices, salt, oil and combustibles per household member. They also could afford higher expenses for education and frequently supported higher education of some of their members. Differences between families from class 1 and 3 concerned in particular the lower cereal consumption and expenses for clothing per family member and the lower consumption of combustibles per family of class 3. Whilst the families' age structure explained the first two items, family size was no sufficient explanatory variable for the latter, since correlation to combustible consumption was low. Differences in consumption concerned particularly combustibles that are used also for heating, such as charcoal and fuelwood. This supports the assumption that families of class 1 and 3 were not able to satisfy all their energy demands by purchase. A further indicator for the direct increase of living standard due to fuelwood collection was the annual heating period, which was about one month longer in households of class 1. Sylvopastoralism had no direct impact on living standard, since meat and milk consumption were about the same in both classes of poorer families.

A comparison with the ranges of annual variations showed that income and liquidity in 1989/90 were slightly below average in all three classes. All three classes showed about the same range of relative variations.

3.3 Interaction with the local forestry resources

In 1989/1990, community members collected about 1,358 tons ($cl_{90} \pm 301$ tons) of combustibles which corresponded to an optimistic estimation of the annual litterfall production of the communal forest resources. The litterfall comprised dead branches, cones and a part of the needle production. In comparison to the estimated annual fodder growth of about 470 to 590 MJ/ha of metabolizable energy (FAO, 1988), forest sites were already overstocked by the officially recorded 1,593 sheep, 772 goats and 563 cattle. Consequently, natural regeneration of forests could not take place. The maximal number of livestock permitted by the local forest authorities was not even reached according to administrative records as well as to survey estimates.

The output from forests in the year of the survey reflects only a relatively static image with regard to the dynamics of forest growth. Pines in the study area were in an age, where annual litterfall production is approximately highest. Enhancement of annual fodder production without pasture management would require wider stand spacing, which is already low. Sustainability, that is ensuring or even improving the current level of outputs from the existing community forests for the future, would require a change of the actual forest management. This concerns adapting the stand age structure as well as regulation of forest utilization and distribution of benefits from forests.

4 Conclusion

The analysis of economic determinants for decisions in farming systems showed that contribution to family income was no sufficient criterion for explaining the local

population's behaviour in forest utilization. Constraints from liquidity and family needs were of equal importance or even more decisive. Growing living standard and availability of cash diminished fuelwood collection, provided that supply with alternative energy by purchase is possible. The sufficient availability of labour in all households and the low, insignificant correlation between labour capacity and type and intensity of forest utilization indicated, that labour capacity played no role in decisions.

Livestock holders in the study area would do better without forests at least in the short run, since unwooded communal area is free and available throughout the year. In the study area, access to forest pasture is only an advantage as long as farmers have no influence on land use planning and forests constitute fixed external conditions for the farming systems. However, environmental impacts, such as erosion of pastures and arable land, may potentially level out or even exceed this advantage in the long run. Analysis in this domain requires long term research and rises simultaneously the question about alternatives, as for example agro-forestry approaches, in order to avoid those negative impacts.

Consequently, the problem of preserving forests in the study region was that, on the one hand poorer families had no alternative for replacing contributions of forests to their living standard. On the other hand, those contributions were not essential enough to create a communal interest in forest preservation. Taking participation of the local population in forest management as an indispensable prerequisite for sustainable forestry (STEINLIN, 1979), two alternative approaches for solving this dilemma are, at least theoretically, conceivable. The one is, to enhance interest of the families in afforestation by increasing the contribution of forests to their economic success. Therefore, introduction of direct participation in revenues from timber sales is an obvious possibility. The other approach is the renunciation of the communal plantation type forestry approach in favour of promoting agro-forestry approaches at the farmers' level.

5 Summary

In Morocco, human impacts lead to a growing deforestation that are likely to surpass in future the reforestation efforts by the national forest service. Consequently, considering local requirements is of increasing importance in forestry planning. In order to determine the role of plantation type forests in the economy of local families, a representative double-stage survey was conducted in a rural community in Central Morocco.

People in the community used forests for sylvopastoral activities, combustible and herb collection. Results from the first survey allowed distinction of three classes of farming systems by parameters about realized and potential forest utilization. A more profound analysis of these classes was the subject of the second survey. The results substantiated the classification due to significant differences in economic characteristics.

Forests played a role as a resource nearly exclusively for farming systems of the first class. Farming systems of the other classes were either able to replace products from forests by purchase and by products from own sources (class 2) or had to get along with

restricted access to forests due to different reasons (class 3). For members of class 1, contribution of fuelwood to income amounted to only 2.4% in average, but allowed substitution of cash expenses for combustibles and longer heating periods in the cold season. Those farming systems also sent on average the largest number of livestock to forest pasture. The importance of forest pasture derived more from the period of availability than from the contribution to the annual fodder demand, which was with 5% to 7% relatively low.

Families from class 3, which had family incomes comparable to those of class 1 but significantly more family members, were not able to replace fuelwood from forests by purchase. Contributions of livestock husbandry to their family income were about the same as for families from class 1. Families from class 2 had higher incomes and more cash available than the families from the other classes. They refrained from fuelwood collection even if labour capacity was no limiting factor and despite their expenses for combustibles, that were two to three times higher than those in the other classes.

Consequently, constraints of liquidity and household supply seemed to be of greater importance for decisions about forest utilization than maximization of income. In general, contribution of forests to living standard of forest users was low, even if community members collected all available litterfall for fuelwood and forest pasture was already overstocked. A potential source for enhancing the incentives on the farmers' level and thus the population's interest in preservation of communal forests in future are the revenues from timber sales. These revenues are actually awarded to the community's budget and do not lead to recognizable effects on the families' level.

Der Beitrag von Kiefernforsten zum Lebensstandard in Haushalts und Betriebssystemen im Massif de Zerhounne, Zentral-Marokko

Zusammenfassung

Die durch Menschen verursachte Entwaldungsrate in Marokko wird in Zukunft voraussichtlich die Wiederaufforstungsbemühungen des staatlichen Forstdienstes übersteigen. Entsprechend gewinnt die Berücksichtigung der Bedürfnisse der lokalen Bevölkerung bei der Forstplanung immer größere Bedeutung. Die Rolle von Forstplantagen in der Ökonomie von Forstanrainerfamilien wurde mittels einer repräsentativen zweistufigen Erhebung in einer ländlichen Gemeinde in Zentral-Marokko erfaßt.

Die Mitglieder der Gemeinde nutzten Forstflächen als Waldweide und zur Sammlung von Brennstoffen und Kräutern. Als Ergebnis der ersten Erhebung konnten dabei aufgrund von Merkmalen der realisierten und potentiellen Forstnutzung drei Klassen von Betriebs-Haushalts-Systemen unterschieden werden. Die Ergebnisse der zweiten Erhebung, die zur umfassenderen Analyse der Klassen diente, bestätigten die Klassifizierung durch signifikante Unterschiede in der Ausprägung ökonomischer Kenngrößen.

Danach stellten Forste nur für die erste Klasse eine wichtige Ressource dar. Betriebs- und Haushalts-Systeme der anderen beiden Klassen konnten Forstprodukte durch Zukauf und Nutzung eigener Ressourcen ersetzen (Klasse 2) oder mußten aus verschiede-

nen Gründen mit beschränktem Zugang zu den Forsten auskommen (Klasse 3). Der Einkommensbeitrag von Feuerholz bei Mitgliedern der Klasse 1 belief sich durchschnittlich zwar nur auf 2,4%, erlaubte jedoch die Substitution von Barausgaben für Brennstoffe und das Heizen über einen längeren Zeitraum in der kalten Jahreszeit. Mitglieder dieser Klasse hielten die im Durchschnitt größte Anzahl von Tieren auf Waldweide. Die Bedeutung der Waldweide leitete sich dabei mehr aus dem Zeitraum ihrer Verfügbarkeit und weniger vom Beitrag zum jährlichen Futterbedarf ab, der mit 5% bis 7% relativ gering war.

Familien der Klasse 3 hatten mit Klasse 1 vergleichbare Einkommen aber signifikant mehr Familienmitglieder. Die fehlende Möglichkeit zur Brennstoffsammlung in Forsten konnte von ihnen nicht über Zukauf kompensiert werden. Der Einkommensbeitrag der Tierhaltung entsprach in etwa dem in Klasse 1. Familien der Klasse 2 hatten höhere Einkommen und verfügten über mehr Barmittel als die Familien der beiden anderen Klassen. Sie verzichteten auf die Sammlung von Feuerholz, obwohl hinreichend Arbeitskraft verfügbar war und trotz ihrer, im Vergleich zu den anderen Klassen, zwei- bis dreimal höheren Ausgaben für Brennstoffe.

Dies weist darauf hin, daß Entscheidungen über die Forstnutzung in stärkerem Maße von Liquiditätsengpässen und Haushaltsbedürfnissen als vom Kriterium der Einkommensmaximierung bestimmt werden. Der Beitrag aus Forsten zum Lebensstandard war insgesamt jedoch gering, trotz der Nutzung des gesamten Sammelholzes und Streus und der bereits bestehenden Übernutzung der Waldweide. Eine potentielle Quelle zusätzlicher Anreize auf Ebene der lokalen Familien zur Steigerung des Interesses der Bevölkerung am Walderhalt stellen die Erlöse aus dem Stammholzverkauf dar. Diese Erlöse kommen zum gegenwärtigen Zeitpunkt dem Gemeindebudget zugute, haben jedoch keine wahrnehmbaren Auswirkungen für die einzelnen Gemeindemitglieder.

La contribution des forêts de pin au niveau de vie dans des systèmes agraires du massif de Zerhoun, Maroc Central

Sommaire

Au Maroc, la déforestation due aux impacts humains s'aggrave à un taux qui va probablement dépasser à l'avenir les efforts de reboisement du service national forestier. Par conséquent, la prise en compte des besoins de la population locale devient de plus en plus importante au niveau de la planification forestière. Par le biais d'un double échantillonnage représentatif, nous avons essayé de déterminer le rôle des forêts du type plantation sur le plan économique des familles locales dans une commune rurale au Maroc Central.

L'exploitation des forêts par la population de ladite commune comprenait des activités sylvopastorales, la collecte des combustibles et des herbes. Les résultats du premier sondage ont permis la distinction entre trois (3) classes des systèmes agraires sur la base des paramètres concernant l'utilisation réelle et potentielle des sites forestiers. Les résultats du deuxième sondage, servant à l'approfondissement de l'analyse des classes,

ont confirmé la classification sur la base des différences significatives quant aux grandeurs économiques.

Les forêts ne jouaient un rôle de ressource qu'au niveau de la première classe. Les membres des deux autres classes étaient capables de remplacer les produits forestiers au moyen des achats et par des produits provenant des ressources propres (classe 2) ou étaient forcés de s'en sortir, face à l'accès limité aux sites forestiers dû à différentes raisons (classe 3). Pour les familles de la classe 1 la contribution du bois de chauffe aux revenus ne s'élevait qu'à 2,4 % en moyenne mais permettait la substitution des achats de combustibles et une prolongation de la période de chauffe pendant la saison froide. En outre, lesdites familles envoyaient le plus haut nombre du bétail sur le pâturage forestier. L'importance du pâturage dérivait plus de sa disponibilité que de sa contribution au besoin annuel d'alimentation du bétail, contribution relativement faible avec un taux de 5% à 7%.

Les familles de la classe 3, réalisaient des revenus familiaux comparables à ceux dans la classe 1 mais avec un nombre de membres significativement supérieur, étaient incapables de remplacer à l'aide des achats le bois de chauffe provenant des sites forestiers. Par rapport aux deux autres classes, les familles de la classe 2 avaient des revenus supérieurs et disposaient de plus des fonds liquides. Elles renonçaient à la collecte de bois de chauffe malgré que la disponibilité de la main-d'œuvre ne fût pas un obstacle et en dépit de leurs dépenses pour les combustibles, deux à trois fois supérieur par rapport aux autres classes.

Par conséquent, les délimitations des fonds liquides et de l'approvisionnement du ménage semblaient être plus importantes quant aux décisions concernant l'utilisation des ressources forestières que l'objectif de la maximisation des revenus. La contribution totale des forêts au niveau de vie a été peu important bien que les membres de la commune collectaient tous le bois mort et la litière et que les pâturages forestiers fussent déjà surexploités. Les revenus provenant de vente de bois d'œuvre constituent une source potentielle pouvant augmenter les incitations au niveau des paysans et partant, l'augmentation de l'intérêt de la population à la conservation des forêts communales. En ce moment lesdites revenus profitent au budget communal et n'ont pas d'effets perceptibles au niveau des familles.

6 References

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