On-farm Agrobiodiversity in West Asia: Status, Threats and Impact on Rural Livelihoods

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Executive Summary

Since 1999, ICARDA has been coordinating a five-year project funded by the Global Environment Facility (GEF) to promote on-farm/*in situ* conservation and sustainable use of dryland agrobiodiversity. The project, implemented in Jordan, Lebanon, Palestine and Syria, focused on conserving landraces and wild relatives of barley, wheat, lentil, alliums, feed legumes, and fruit trees.

Project activities were implemented by national research institutes in each country: the National Center for Agricultural Research and Technology Transfer in Jordan, the Lebanese Agricultural Research Institute in Lebanon, the General Commission for Scientific and Agricultural Research in Syria, and the Ministry of Agriculture and UNDP Program of Assistance to Palestinian People in Palestine. Farmers and herders were fully involved throughout the project.

The project developed a community-driven approach that helped increase awareness, at all levels, of the benefits and need to conserve agrobiodiversity. It has also prompted research institutions in Jordan, Lebanon, and Syria to implement their own agrobiodiversity programs; and national authorities to make greater use of wild relatives of fruit trees in afforestation efforts.

A detailed socioeconomic assessment was conducted in 2004 and 2005 (building on a baseline survey in 1999-2000) to assess the impacts of the project on livelihoods of local communities. ICARDA researchers and national partners surveyed 276 households that had participated in the project and 294 households that had not. These surveys were conducted in the eight project target areas (two per country) in August and September 2004, using a formal questionnaire. The survey covered various topics including household livelihood strategies, household and farm assets, sources of income, and access to credit, cooperatives, and healthcare.

The study compared livelihood strategies, agrobiodiversity use, and incomes (i) within and across countries, (ii) among poorer and better-off households. Using factor analysis, households were classified into four wealth groups or quartiles, taking into account all types of capital—human, natural, financial, physical, social—available to a household.

Livelihood strategies: Conservation practices and investments must be appropriate to local livelihood strategies, agroecological conditions and the farming production system. In all four countries, the poorest households (lowest wealth quartile) obtained their income mainly from crop production, although off-farm labor and government employment were also important. By contrast, households in the

highest wealth quartile mainly depended on the sale of livestock products and live animals, though they also produced crops and worked off-farm, including government employment. Over all wealth groups, livestock was the main source of on-farm income in Jordan, while crops and fruit trees were the major source in Lebanon, Palestine, and Syria. Overall, off-farm income was important in all the target areas, accounting for 43-68% of household income. Clearly, although agriculture was not the only source of income, it was still a major component of livelihoods.

Importance of target crops by wealth group: The relative importance of different crops to a household depended on the household's wealth level. Wheat and barley were more important for better-off farmers, while apricot and apple were more important to poor farmers. In all groups, fruit trees were generally more important than field crops. This finding has important implications for national and international efforts to conserve agrobiodiversity. It suggests that *in situ* conservation of cereal crops should focus on well-off farmers; whereas fruit tree conservation is more appealing for poorer farmers. Appropriate conservation strategies will improve the livelihoods of all farming groups, especially the poor, and contribute directly to poverty reduction.

Project impacts on agricultural incomes: Average household incomes ranged from US$2200 to 9000 per year, equivalent to a daily per capita income of less than US$1 to US$5. Per capita incomes were around US$2 per day in Jordan, Lebanon, and Jenin (Palestine), and lower in Syria and Hebron (Palestine). Agriculture provided 32-57% of household income. In most cases, households that participated in the project had average agricultural incomes greater than those of non-participating households; the difference was US$1148, US$1754 and US$1914, in Syria, Jordan and Lebanon, respectively. Gini coefficients were calculated to assess income equity within participating and non-participating households in each country. The values were not significantly different, indicating that enhancing agrobiodiversity did not increase inequalities between poor and well-off farmers. The results highlight the importance of agrobiodiversity conservation in improving the livelihoods of all segments of farming communities. However, to be effective, research should be based on the importance of targeted species to different farming groups. This study provides clear indications that diversification of farming systems to include livestock, field crops and fruit trees, along with off-farm activities, are needed to conserve and sustain the use of agrobiodiversity.

1. Introduction

The alarming loss of biodiversity prompted more than 185 countries and parties to sign the Convention on Biological Diversity launched at the World Summit at Rio de Janeiro in 1992. Agricultural biodiversity or agrobiodiversity, the most important component of the biodiversity, encompasses the variety and variability of plants, animals and microorganisms at genetic, species and ecosystem levels; all of which are necessary to sustain key functions in the agroecosystem, underpinning food production and security. Local knowledge and culture are integral parts of agrobiodiversity, since the human activity of agriculture conserves and reshapes biodiversity through sustainable use.

Agrobiodiversity is highly dynamic, being determined by a matrix of 'human' factors and feedbacks, in addition to environment. There is increasing realization of the importance of agrobiodiversity in ecosystems, and at the species and genetic level; and the agroecosystems approach to agrobiodiversity conservation is widely promoted.

There are several unique characteristics of agrobiodiversity: (1) agrobiodiversity is actively managed by farmers, necessary for many components of agrobiodiversity to survive; (2) indigenous knowledge and culture are integral to agrobiodiversity management; (3) many economically important farming systems are based on introduced 'alien' crop species, creating international interdependence for the basic genetic resources; (4) diversity within species is as important as diversity between species, as it allows for the adaptation to changes in environment, human needs and breeding programs.

Farmers in both 'traditional' and 'industrial' agricultural systems rely on agrobiodiversity in their production strategies. In more intensive systems, crop diversity may be lower because of the extensive use of varieties in monoculture. The development of new varieties depends on genetic resources stored in gene banks and used by plant breeders off-farm. Non-crop agrobiodiversity that includes wild relatives may remain significant on-farm at field edges and in remaining natural habitats, and may be very important for ecological buffering. In more traditional systems, farmers actively manage agrobiodiversity on-farm to improve productivity, maintain sustainability, and adapt to changing requirements. Global food security depends significantly on industrial agriculture, giving emphasis to the importance of agrobiodiversity to global food production as well as sustainable livelihoods in more traditional agriculture. In addition to production effects, agrobiodiversity also contributes indirectly to sustainable livelihoods by providing important ecosystem functions and services; it contributes to a wide range of liveli-

hoods, mostly in harsh conditions. The challenge is to create a new environment that makes returns to the maintenance of agrobiodiversity more sustainable and more accurately reflect agricultural biodiversity's true value to the livelihoods of different stakeholders and to sustainable agricultural development and food security.

However, unless there are clear economic benefits to conserve biodiversity, it is unlikely that individuals, households, communities, companies, or governments will do so. People will continue to degrade and deplete biodiversity and natural resources for quick benefits. Landraces of major crops conserve adaptations to low inputs and harsh conditions, and respond well to local requirements for food and feed; they sometimes have a price premium because of these quality attributes.

Research and extension efforts have concentrated on technologies for intensive agriculture and little effort has been made for traditional systems with their crop, livestock, range, and forest components. These components of local agrobiodiversity have potential in combating climate change, global warming, and desertification. In addition, they can provide a large genetic base to sustain genetic gains targeted by breeding programs worldwide. The global and local significance of these genetic resources call for local, national, regional and international efforts to safeguard the remaining plant and animal agrobiodiversity. This need is pressing for remaining biodiversity in the major centers of diversity of crops and fruit trees of global importance.

2. Conservation and Sustainable Use of Dryland Agrobiodiversity Project

The conservation of dryland agrobiodiversity is essential for sustainable agricultural development and food security, and to overcome desertification and climate change effects. While *ex situ* collections safeguard samples of existing diversity, and recent emphasis has been on *in situ* conservation of agrobiodiversity—a dynamic preservation of the ecosystem components. West Asia encompasses one of the world's three mega-centers of major crop diversity for wheat, barley, lentil, and many forage, vegetable, medicinal, herbal, and aromatic species, as well as fruit tree species that include olive, almond, pistachio, fig, and grapes. The biodiversity in the West Asia region has a large within-species genetic diversity and many endemic species. The indigenous crops and food plants of this region are resistant to many biotic and abiotic stresses, making them valuable for germplasm enhancement, upon which global food security depends.

The Near East region supports some 54 million people, with an average annual population growth rate of 3%; and agricultural production is the principal economic activity for most people. To achieve national food security, agriculture has been intensified and expanded, thus degrading natural vegetation, soils, and water. Genetic diversity is being seriously eroded by natural habitat destruction, intensification and expansion of cultivation, and overgrazing of rangelands and forests. Overgrazing is especially threatening annual herbaceous species such as wild relatives of wheat, barley, and lentil. For tree crops and their wild relatives, regeneration can be seriously impaired by overgrazing and deforestation for expanding urbanization or agriculture. The replacement of the traditional farming by modern methods is endangering landraces. In addition, food demands and economics have encouraged change from locally adapted varieties (landraces and local varieties) to higher yielding cultivars of both fruit trees and field crops, thus reducing their gene pools.

"Conservation and Sustainable Use of Dryland Agrobiodiversity" was a five-year project launched in 1999 to promote *in situ* conservation and sustainable use of dryland agrobiodiversity in Jordan, Lebanon, Palestinean Authority, and Syria. The project is funded by the Global Environment Facility through the United Nations Development Program (UNDP), and was coordinated regionally by the International Center for Agricultural Research in the Dry Areas (ICARDA). ICARDA also facilitates networking and regional integration and provides technical backstopping and training, requested by national partners, in cooperation with the International Plant Genetic Resources Institute (IPGRI) and the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD). The project focused on

conservation of landraces and wild relatives of barley, wheat, lentil, alliums, feed legumes (*Lathyrus*, *Medicago*, *Trifolium*, and *Vicia* spp.), and fruit trees (olive, fig, almond, pistachio, plum, peach, pear, and apple). A comprehensive approach involving the major stakeholders, principally farmers and herders, and including the major ecosystems and farming systems was used.

The project strategy was to develop community-driven *in situ* and on-farm agrobiodiversity conservation initiatives in representative areas of global agrobiodiversity significance. Land users as primary participants are fundamental to agrobiodiversity management. The combining of specialized international and regional institutions with national institutions in the project greatly enhanced the synergism of the project, and awareness promotion was a priority at all project levels. Innovative approaches to *in situ* and on-farm conservation were developed alongside appropriate resource management to maintain the productivity of resources and the economic viability of the community. The project strengthened institutional and community capacity, to promote a progressively greater national contribution to agrobiodiversity conservation and management.

The main objectives of the agrobiodiversity project were:
- Introduction of local agrobiodiversity conservation to national biodiversity and agricultural strategies.
- Strengthening the science of *in situ* on-farm conservation of local agrobiodiversity and its assessment and monitoring.
- Developing sound strategies and approaches for community-driven *in situ* on-farm conservation including technological, value-adding and alternative sources of income, and institutional and policy options.
- Identifying biodiversity-rich areas for conservation, sampling of genetic diversity, assessment and monitoring of major threats.
- Capacity building and public awareness.

The major areas of investigation within the project incorporated:
- Ecosystem management approach (extending work to non-mandated species including trees, medicinal, herbal, and aromatic species).
- Sustainable livelihood approach (focusing on value-adding technologies and alternative sources of income).
- Community participation and empowerment (policy and legislation reforms, property rights and benefit sharing, and increasing public awareness).
- Necessity for regional integration and networking.

The beneficiaries from the project will be:

- Communities within the target sites and other rural communities who depend on the sustainable use of the genetic resources of the target species in agricultural production.
- National programs of the participating countries, through institution strengthening and staff training in agrobiodiversity conservation.
- Ultimately, the entire population (and future generations) of the countries will benefit from the conservation of these agricultural genetic resources.
- Farmers in the target areas, who are anticipated to adopt some technologies introduced and tested by the project and increase their income.

The project had five components; the four participating countries had their own nationally executed component and a national project manager, with a coordinating regional component run by ICARDA. The regional coordinator ensured tight linkages between the four national projects and facilitated positive impacts from networking and exchanges in experience and expertise. ICARDA and technical partners, such as IPGRI and ACSAD, provided technical assistance and training for the national participants. The project activities were implemented at the national level by the National Center for Agricultural Research and Technology Transfer (NCARTT) in Jordan, Lebanese Agricultural Research Institute (LARI) in Lebanon, and General Commission for Scientific and Agricultural Research (GCSAR) in Syria and the Ministry of Agriculture and UNDP/PAPP in Palestine. Thematic groups, including a socioeconomic and policy group, were established to ensure standard methods, the implementation of project activities, and the complementarity among the prevailing ecosystems.

3. The Study Areas

Target areas were selected to capture the maximum genetic diversity of the target crops in the minimum number of areas. Thus they were selected for the presence of target species, to be representative of major and complementary ecosystems, and suitability of working conditions, which include willingness of local communities to participate, and the potential for impact.

In each participating country, two target areas were selected; with two to six sites within each chosen for diversity of environments and farming systems (Table 1 and Map 1). Socioeconomic characteristics of these areas are summarized in Table 2. The focus was on 16 target crops (or crop groups) of global significance and their wild relatives, all of Near East origin and subject to severe genetic erosion.

Map 1: Location of the target areas in the four countries

Table 1: Some characteristics of agrobiodiversity in the target areas in the four countries

Country/target areas		Target area's main characteristics
Jordan	Ajloun	Mountainous area with steep slopes and valleys, 75 km north of Amman. Sub-humid Mediterranean climate, 80% of soils are shallow. Vegetation cover mainly indigenous forest of *Pinus* and *Quercus* with wild species of pistachio, plum and almond. Wild relatives of cereals and forage species found in undisturbed areas and in agricultural landscapes. Overgrazing and land reclamation are major threats to biodiversity. Two natural reserves are located in this region.
	Muwaqqar	A dry area located on the plateaus and hills south of Amman, representing the steppe zone. Highly calcareous soils eroded by wind and water. Open grazing and barley growing are predominant land uses. Supplementary-irrigated olive orchards are developing. Wild barley, wild species of *Aegilops*, *Vicia* and *Lathyrus* and local varieties of olive, grapes, figs, and almonds found in a few irrigated orchards and home gardens. Jordan University has introduced *Atriplex* spp. and is experimenting with water harvesting techniques. Overgrazing is the major threat to biodiversity. Urbanization and expansion of barley and olive cultivation is restricting the range areas.
Lebanon	Baalbak	A flat plateau rising steeply on one side to 1700 m. Includes the localities of Nabha (west of Beqaa in the Lebanon mountains) and Ham-Maaraboun (east, Anti-Lebanon mountains). Semi-arid climate, highly calcareous soils. Dryland farming of field crops and fruit tree orchards are predominant. Over 500 plant species, of which many are endemic. Wild relatives of cereals, legumes and fruit trees are found. Habitat fragmentation, deforestation and overgrazing are threatening wild relatives; landraces being replaced by improved cultivars or introduced fruit trees.
	Aarsal	It is part of the Anti-Lebanon mountain range with climate ranging from arid to semi-arid. Soils are predominately calcareous and alluvial soils are found in the valleys. The area is used for open grazing and to grow barley and wheat. The planting of grapes and cherries is progressing. Wild relatives of cereals, legumes and fruit trees and many forage species are found in very restricted areas. Overgrazing and quarries are the main factors of degradation of natural habitats and local agrobiodiversity.
Palestine	Jenin	Hilly region sloping down to the Jordan Valley, climatic gradient from semi-arid to arid. Soils are alluvial and dark Rendzina with some basaltic pockets that are lost through overgrazing. Natural reserves exist. Cereals, food legumes, vegetables, and olive trees cultivated. Wild species of cereals, legumes, and forage species are found, but threatened by habitat destruction and overgrazing.
	Hebron	Includes the mountain slopes of Hebron and the nearby hills in the south and east. Semi-arid Mediterranean climate. Terra Rossa soils predominate in the mountains, alluvial soils in plains and valleys. Landraces as well as many wild relatives of cereals, food and feed legumes, and fruit trees are found. Overgrazing (and quarries in some areas) are the major threats to agrobiodiversity.
Syria	Al-Haffeh	Extends from 500 to 1000 m altitude on the Slenfe mountain. Humid and sub-humid climate with Mediterranean influence. Forest containing wild species of fruit trees predominates. In cultivated areas, landraces of cereals, food legumes, and fruit trees are still used. Deforestation, land reclamation, overgrazing, and expansion of olive and citrus plantations are threatening biodiversity.
	Sweida	Mainly mountainous area with a climate ranging from sub-humid to arid. Soils of basaltic origin. Dryland farming with cereals, food legumes and forages. New plantations of apple trees and grape vines are expanding rapidly. Unique area for biodiversity, with 900 wild species of cereals, food legumes, and pistachio. Overgrazing, expanding apple orchards and destruction of natural habitats are affecting biodiversity significantly.

Table 2: Most important socioeconomic characteristics of the target areas in the four countries

Country/target areas		Main socioeconomic characteristics of the target areas
Jordan	Ajloun	Most people in the area are educated, over 57% of households had one member with a university degree. Families are medium-sized, on average. Average farm size about 6 ha, where 1.6 ha is irrigated. Poverty is low, about 2/3 of household income came from off-farm activities. Excellent availability of cooperatives, schools, telephones, electricity, and public clinics. The majority of households had land planted with trees, and livestock were not important. Average annual household income about US$5500.
	Muwaqqar	This site is located in dry areas (Badia). Average farm size about 18 ha, average family size about 9 persons. About 52% of households had one member with a university degree, but 1/3 of household heads are illiterate. Shortage of wage labor when needed. About 2/3 of households see themselves as moderately well-off, and off-farm income represents about 2/3 of total household income. Average annual household income about US$8300 (mainly from livestock).
Lebanon	Baalbak	Average farm size about 6 ha divided into 8 plots; most of the land is owned by farmers. Common rangeland around the villages is available, but relatively few sheep and goats per household. Schools, public clinics, electricity, and telephones available to most households in the cities nearby. Average household size 7 persons. Average annual household income about US$7000. 1/3 from off-farm sources and 1/3 of other income is from fruit tree production. More than half the households see themselves as moderately well-off.
	Aarsal	Average farm size about 6 ha divided into 7 plots. Average family size 9 persons, annual household income about US$7200, of which 58% is from off-farm activities and 30% from fruit trees. About 1/4 of households had one member with a university degree, and 3/4 of households see themselves as moderately well-off. Schools, public clinics, electricity, and telephones are available to most households.
Palestine	Jenin	Average farm size 6 ha, where 1.4 ha is planted with trees. All farmers owned their own land, which is divided, on average, into 5 plots. Average family size 9 persons, annual household income about US$ 8700, of which 43% comes from off-farm activities, and 33% from crop production. About 1/2 of the households had a member with a university degree, and 1/3 of the household heads had work opportunities outside their areas. Schools, public clinics, electricity, and telephones available to most households.
	Hebron	Farm size about 9 ha distributed into 6 plots. Non-arable lands represented about 40%, on average, of the farm size. Average family size 13 persons, annual household income about US$9000, of which 59% comes from off-farm activities. About 60% of the households had a member with a university degree, and only 5% of household heads had work opportunities outside their areas. Schools, public clinics, electricity, and telephones available to most households.
Syria	Al-Haffeh	Average farm size is small (about 0.9 ha in 3 plots), where 0.8 ha is planted with trees. Average family size about 8 persons and annual household income about US$ 2200, of which 46% comes from off-farm activities and another 46% from tree production. Schools, electricity, and telephones are available to most households.
	Sweida	Average farm size 9 ha distributed into 9 plots and 2.5 ha are planted with trees. Family size 8 persons, average annual household income about US$3700, of which 43% is from off-farm activities and 30% from tree production. Schools, public clinics, electricity, and telephones are available to most households.

4. Socioeconomic Survey

In 2004 the West Asia Dryland Agrobiodiversity Project conducted a formal survey in collaboration with ICARDA social scientists and national teams. This survey covered all target areas in the four participating countries, the survey objectives were to:

- Assess the impact of the project on conserving agrobiodiversity in targeted areas.
- Assess the benefits of the value-added, income-generating activities introduced by the project on livelihoods.
- Assess the gender dimension of agrobiodiversity conservation.
- Identify potential options that contribute to the development of "community development plans" for targeted communities.

Households were randomly selected and interviewed in all target areas including both households that participated in project activities and those who did not (Table 3).

Table 3: Classification of sample farms by type of participation (% of farmers)

Type of participation	Jordan	Lebanon	Palestine	Syria
Agrobiodiversity enhancement	15	30	60	33
Value-added, income-generating activities	7	9	0	10
Field days & training	17	5	1	7
Non participants	61	56	39	50
Sample size (N)	145	138	140	147
% of female respondents from total sample	21	3	1	0

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5. Methods

5.1 Questionnaire development

In July 2003, an initial training workshop in Amman, Jordan with representatives of the four components was conducted by the biodiversity project and ICARDA social scientists. The workshop focused on theoretical aspects and implementation of community participation and sustainable livelihood approaches in relation to agrobiodiversity conservation.

A draft questionnaire was prepared by the ICARDA socioeconomic group from the baseline survey form used by the project teams in year 2000. This was sent to the national teams for reviewing and comments; a meeting in March 2004 discussed the questionnaire and the comments of national teams, and some alterations were made. The questionnaire was prepared in English and translated into Arabic. The questionnaire was pre-tested in June 2004, and further alterations were made. The questionnaire focused on the following main themes:

- Participation in the project
- Household structure and income source
- Cropping systems and cultural practices
- Changes in land use
- Seed and seedling production, use and exchange
- Household assets
- Gender activities
- Farmer perception of the project

5.2 Sample size and data collection

Sample size is dependent on the level of heterogeneity among members of targeted population and the cost of data collection. In targeted communities, farmers are homogeneous in terms of their livelihood strategies, production systems and agricultural practices related to agrobiodiversity use and conservation. Under such conditions, samples determination does not require sophisticated sampling aproach.

Household in the target areas of this study are characterized by low variability with respect to their income level and size of holdings. Based on the recommendations of Collinson (1982) that a sample of 50-60 farmers is enough for such studies. A random sample of about 70 households in each target area were selected randomly. Forty to sixty percent of the sample had participated in project activities, and the others had not (Table 3). The data collection was performed in August-September 2004.

5.3 Data analysis

The collected soscioeconomic survey data were reviewed for accuracy before creating the database. Then, the data were entered and cleaned to ensure consisting with routine SPSS procedures. Descriptive statistics such as frequency distributions, means, cross-tabulations, and charts were used for data analysis. Principal Components Analysis was used to estimate the wealth index for each household.

5.4 Indicators of agrobiodiversity

To evaluate on-farm agrobiodiversity in the target areas, the following indicators were used:

a. Crop diversity (i.e number of crop species or species richness of the farm)
b. Number of landraces of each crop
c. Previous crop before planting fruit trees
d. Land topography
e. Importance of a crop at farm level
f. Cultivation method
g. Use of pesticides and herbicides
h. Introduction and use of new varieties in the farming system
i. Intensification degree of local varieties
j. Comparison between productivity and other attributes of new and local varieties in good and bad seasons
k. Seed and seedling production mechanisms
l. Seed and seedling sources
m. Dissemination of seed and seedling technologies inside and outside the village
n. Contribution of on-farm income to household income
o. Family size and farm size
p. Farmer education
q. Farmer age.

6. Main Findings

6.1 Household characterization

6.1.1 Socioeconomic characterization of the sample

Households are characterized by main household assets, which include the natural, physical, financial, human, and social capitals (Table 4). Total holding area by household ranged from 9 dunums (1 dunum or du = 0.1 ha) at Al-Haffeh, a mountainous area in Syria, to 175 du at Muwaqqar, plain and plateau in Jordan. This variation in area is due to many reasons, but principally population density and ecology of the target area with restricted agricultural land in mountainous areas. Most farmers owned their land, except at Muwaqqar where some either rented land or had share-cropping arrangements. Common rangelands were available for the majority of households, except in Jordan where rangeland was only available to 20%. Drinking water resources were available to most households, except in Sweida where only 7% of households had a water resource. The proportion of irrigated areas was low in all target areas.

Average family size was 7-13 persons per household; work opportunities outside the target area were 6% in Hebron, Palestine and up to 45% in Al-Haffeh, Syria. Wage laborers were available when needed in all target areas, except Muwaqqar. Some household heads were illiterate (Appendix, Table 1), but others had a university degree. Generally, the education level was higher in Jordan and Palestine, compared to Syria and Lebanon. Most farmers classified their livelihood level as moderately well-off, except farmers in Ajloun, Jordan where only 44% classified themselves as well-off.

Off-farm income is important in all the target areas and was 43-68% of total income (Table 4). Average annual household income ranged from US$2200-9000, implying daily per capita income of < US$1-US$5. Average household expenditures were US$100-12,000; it is notable that the expenditures were higher than total income in Palestine and in Al-Haffeh, Syria. On the other hand, income per person per day was calculated as around US$2 in Jordan, Lebanon, and Jenin (Palestine), but < US$2 in Syria and Hebron (Palestine).

Agricultural cooperatives were available but most farmers were not members, except Sweida, Syria where about 85% were members in Farmers Union and a herders' cooperative. Most farmers owned their houses, but few owned a tractor, car, or pick-up. Many farmers had livestock, sheep, goats, or cows, but flock size changed between target areas; larger in dry areas than wetter areas. Schools, public clinics, electricity, and telephones were available to most households. Most households had a separate kitchen, a satellite dish, and TV. The average number of rooms per house was about five.

Table 4: Household assets and major socioeconomic characteristics in the target areas

	Jordan		Lebanon		Palestine		Syria	
	Ajloun	**Muwa-qqar**	**Aarsal**	**Baalbak**	**Hebron**	**Jenin**	**Sweida**	**Al-Haffeh**
Natural assets								
Total holding area (Du)	57	175	63	64	88	59	88	9
Number of plots	2	2	7	8	6	5	9	3
Owned area (Du)	44	74	56	54	74	33	80	8
Area of arable land (Du)	40	173	59	52	53	53	71	9
Irrigated area (Du)	16	3	3	4	1	0	1	0
Having water resource (%)	92	100	74	89	99	96	7	100
Availability of common rangeland around village (%)	14	22	66	83	90	50	74	50
Human assets								
Family size	7	9	9	7	13	9	8	8
Member(s) of the household have a university degree (%)	57.3	52.9	24.7	13.8	47.1	48.6	25.7	31.9
Having work opportunities outside the target area (%)	30.7	14.3	13.7	26.2	5.7	32.9	32.0	44.4
Availability of wage labor when needed (%)	92.0	22.9	94.5	78.5	85.7	95.7	85.3	62.5
Classification of the livelihoods of the household from their perspective (%)								
Very poor	4.0	4.3	4.2	6.2	2.9	1.4	2.7	8.6
Poor	10.7	15.7	12.7	23.1	14.5	22.9	21.3	15.5
Moderately well-off	41.3	67.1	74.6	53.8	76.8	60.0	65.3	65.5
Well-off	44.0	12.9	8.5	16.9	5.8	15.7	10.7	10.3
Financial assets								
Saving money last year (%)	9.3	1.4	8.2	9.2	34.3	24.3	6.8	4.2
Having access to credit (%)	26.7	28.6	57.5	26.2	0.0	50.0	54.1	66.7
Average annual income (US$)	5550	8337	7193	7037	9070	8742	3670	2146
Average expenditure (US$)	2124	4241	6800	4277	9187	11942	3601	3420
Income sources (%)								
Off-farm income	63.2	67.5	58.6	36	59	43	43.2	45.8
On-farm income	36.8	32.5	41.4	64	41	57	56.8	54.2
Crop production	4.2	3	4.6	14.7	18	33	12.6	4.7
Fruit tree production	25.2	2.4	30.7	32.9	10	13	30.5	45.8
Livestock production	7.4	27.1	4.9	14.5	13	13	11.4	3
Social assets (%)								
Having a cooperative in the village	70.7	32.9	81.9	44.6	57.1	66.7	97.3	91.7
Cooperative membership	38.7	12.9	19.2	20.0	7.1	18.6	85.3	44.4
People generally trust a person in the village on issues related to loans and credit	40.0	25.7	42.5	43.1	60.0	58.6	21.3	16.7
Physical assets								
Having owned houses (%)	92	90	99	92	87	100	91	100
Having owned shops (%)	15	6	17	9	16	21	7	6
Having owned tractor (%)	7	0	19	19	17	31	21	6
Having owned car (%)	15	27	14	25	29	21	7	1
Having a pick-up (%)	13	30	52	19	10	0	21	0
Having sheep (%)	1	56	25	14	41	53	29	1
Having cows (%)	7	0	3	6	26	19	23	18
Having goats (%)	13	59	26	29	1	1	23	1
Having bee hives (%)	4	0	1	23	6	10	9	8
Average no. of sheep	0	90	34	4	16	24	10	1
Average no. of goats	11	37	12	13	7	3	4	1
Average no. of cows	0	0	0	0	0	0	1	1
School availability in village (%)	100	99	99	97	100	100	100	96

Table 4: (Continued)

	Jordan		Lebanon		Palestine		Syria	
	Ajloun	Muwa-qqar	Aarsal	Baalbak	Hebron	Jenin	Sweida	Al-Haffeh
Availability of a public clinic in the village or around (%)	97	91	88	46	100	93	79	46
Availability of a telephone in the house (%)	81	83	78	83	59	77	80	68
Availability of electricity in the house (%)	95	96	99	95	96	99	100	100
Having separate kitchen in the house (%)	96	80	96	92	94	94	97	86
Having satellite dish & TV (%)	67	49	49	34	97	70	97	96
Average no. of rooms in house	5	4	6	5	5	5	5	4

Du (Dunum) is 1000 m^2

6.1.2 Classification of sample farms by type of participation

Project participation of the sampled farms was divided into four groups:

- Participants in agrobiodiversity-enhancement activities, which include:
  - Seed treatments
  - Seed distribution
  - Water harvesting for fruit tees
  - Water harvesting for shrubs
  - Fruit trees nurseries
  - Nurseries for rangeland shrubs
  - Reforestation
  - Field genebanks
  - Revegetation of rangeland
- Participants in value-added, income-generating activities, which include:
  - Organic farming
  - Bee keeping (honey production)
  - Food processing
  - Dairy processing
  - Mushroom production
  - Medicinal plant cultivation
  - Home gardens
  - Feed blocks
  - Eco-tourism
- Participants in capacity building activities, which include:
  - Fairs
  - Workshops and meetings with farmers
  - Training courses (on jams, dairy processing, honey, and mushroom)
  - Field days
- Non-participants

Farmer participation in the project was different from one country to another (Table 5), due to the project's focus, as activities varied among countries. For example, most participants in Palestine participated in seed treatment and distribution activities, while in Jordan and Syria farmer participation centered on attending workshops, training, and field days. In Lebanon, most farmers attended farmer workshops and practiced water harvesting for fruit trees. Other farmer participation activities were also important but the degree varied from area-to-area based on farmers' interests and needs.

Table 5: Mapping of sample farms according to participation in activities (% of farmers)

Activities	Jordan	Lebanon	Palestine	Syria
Agrobiodiversity				
Seed treatment	4	12	52	9
Seed distribution	1	1	60	9
Water harvesting for fruit trees	7	14	6	9
Water harvesting for shrubs	4	6	6	4
Fruit tree nurseries	3	7	3	17
Nurseries for shrubs	4	8	7	2
Reforestation	7	7	3	3
Gene banks	3	1	1	1
Re-vegetation (rangeland rehabilitation)	3	5	4	3
Income-generating				
Organic farming	1	9	3	1
Bee keeping (honey making)	2	11	5	13
Food processing (jam and others)	6	4	2	11
Dairy processing	6	1	1	8
Mushroom production	6	1	0	0
Medicinal plants cultivation	6	3	15	3
Home gardens	3	0	2	3
Feed blocks	1	1	0	3
Eco-tourism	5	7	0	5
Capacity building				
Fairs	19	4	4	14
Farmers' meetings/workshops	26	29	53	35
Training (jam, honey, dairy)	23	10	14	22
Field days	26	12	17	32

6.1.3 Farmers' knowledge of the agrobiodiversity project

The analysis indicated that most farmers had known of the project and its activities in their regions; the agrobiodiversity project was the main source of this knowledge, followed by neighbors (Table 6). In Palestine, more than half of farmers received their knowledge from more than one source; neighboring farmers were the main knowledge source for > 10% of farmers in Jordan, Lebanon, and Syria. Compared to Palestine and Syria, NGOs played a greater role in Lebanon and Jordan in transferring knowledge about the project to farmers, due to the greater importance of NGOs in these countries. Agricultural extension sources were relatively important in Jordan (17%) compared to other countries.

Table 6: Farmers' knowledge of the agrobiodiversity project (% of farmers)

Knowledge & source	Jordan	Lebanon	Palestine	Syria
Farmers with knowledge of the project	63	67	80	86
Knowledge source				
More than one source	0	10	51	20
Agrobiodiversity project	50	56	24	53
Neighboring farmers	10	15	8	16
Media	8	0	1	3
NGOs	10	18	0	2
Public institutes	3	0	1	3
Extension services	17	0	2	2
Other sources	2	1	0	1

Table 7: Hearing about the project versus participation (%)

Country	Percentage having heard about the project	Percentage participation in the project
Jordan	63	39
Lebanon	67	44
Palestine	80	61
Syria	86	50

Table 8: Participation in agrobiodiversity project and reasons why farmers who had heard about the project did not participate (%)

Participation & reasons for not participating	Jordan	Lebanon	Palestine	Syria
Participated in project	39	44	61	50
Reasons for not participating				
Lack of incentives	0	0	24	0
Not convinced	0	4	20	0
Not approached by the project	84	44	32	33
Social/economic reasons (age, health, no capital, etc.)	16	52	24	67

Knowledge of the project activities and objectives was not sufficient to participate as there were many factors influencing farmers deciding to participate; the analysis showed a positive relationship between knowledge and participation (Table 7). This suggests the importance of public awareness in encouraging local communities to participate in a project. The reasons for not participating in the project, given by responders who had heard of the project are summarized in Table 8.

6.1.4 Contribution of income sources to total household income

Household farmers in the target areas had many activities to make their livelihoods. They had many income sources, and there were variations in the amount and percentage of income sources among the four countries (Table 9). Income from on-farm activities, including return from crops and fruit trees, livestock products, and live animals represented less than half of total household income.

Table 9: Contribution of income sources to total household income (%)

Income source	Jordan	Lebanon	Palestine	Syria
Crops & fruit trees	16	28	27	34
Livestock products	15	6	6	5
Live animals	11	7	16	4
Total on-farm income	**42**	**41**	**49**	**43**
Off-farm (Agriculture)	3	3	3	1
Off-farm (Non-agriculture)	4	34	26	6
Government employment	48	10	15	20
Remittances (from outside country)	3	1	0	4
Other sources	0	12	10	26
Total off-farm income	**58**	**59**	**51**	**57**
Average household income (US$)	6896	7120	8905	2919

Table 10: Contribution of income sources to total household income by target area (%)

Income source	Jordan		Lebanon		Palestine		Syria	
	Muwaq-qar	Ajloun	Aarsal	Baalbak	Hebron	Jenin	Sweida	Al-Haffeh
Crops & fruit trees	1	38	19	38	22	31	34	34
Livestock products	20	7	5	7	4	7	6	3
Live animals	17	4	8	5	12	20	3	6
Total on-farm income	**38**	**49**	**32**	**50**	**38**	**58**	**43**	**43**
Off-farm (Agriculture)	3	3	4	2	2	4	1	1
Off-farm (Non-agriculture)	3	6	45	22	39	12	2	17
Government employee	54	39	10	11	12	17	12	39
Remittances (from outside country)	2	3	0	1	0	0	6	0
Other source	0	0	9	14	9	8	36	0
Total off-farm income	**62**	**51**	**68**	**50**	**62**	**42**	**57**	**57**

Government employment income as a percentage of household income was important in Jordan (48%) and Syria (20%), while non-agricultural off-farm income was important in Lebanon (34%) and Palestine (26%). Livestock was the main source of on-farm income in Jordan, whereas plant production (crops and fruit trees) was the major source of on-farm income in Lebanon, Palestine, and Syria.

Contribution of income sources to household income was diverse, according to the target areas in each country (Table 10). In Jordan, at Muwaqqar, income from government employment was most important, followed by livestock income; while at Ajloun income from crops and fruit trees was important. In Lebanon, the main source of household income was off-farm activities outside agriculture at Aarsal (mainly from quarrying), and income from crops and fruit trees at Nabha. However, there were many factors that influenced the contribution of alternative sources to income, such as farm resource availability, farmer education, skills and experience, and opportunities for off-farm activities.

6.1.5 Type of enterprise

Farmers had more than one major production activity on their farms, divided into three main enterprise types: only plant production, only livestock production, and mixed (plants and livestock). Enterprise type is an indicator of agrobiodiversity. Plant production in the form of crops and/or fruit trees only was the most important enterprise for most farmers in all target areas, except at Muwaqqar (Table 11) where livestock was predominant. Livestock was marginal in Palestine, Syria and Lebanon (except Aarsal); but was important in Jordan, especially in Muwaqqar. Mixed crop and livestock activity was generally important, especially in Palestine where more than 50% of farmers indicated this enterprise.

6.1.6 Farmer typology according to income level

Households were classified into three groups according to annual income (Table 12). The small income group was dominant in the four countries, although 42% of Palestinian farmers were in the medium group, but it must be considered that the purchasing power of money was not the same in the four countries.

Households estimated the female contribution to household income, across income sources (Table 13). Contribution of females to household income was notable in the four participating countries, especially from crop and livestock incomes. In Palestine, women made a considerable contribution from non-agricultural off-farm activities.

Table 11: Type of enterprise (% of households)

Type of	Jordan			Lebanon			Palestine			Syria		
enterprise	Total	Muwaqqar	Ajloun	Total	Aarsal	Baalbak	Total	Hebron	Jenin	Total	Sweida	Al-Haffeh
Only plants	**47**	**10**	**66**	**71**	**24**	**58**	**43**	**44**	**42**	**67**	**54**	**80**
Crops	3	5	1	5	3	6	10	9	11	1	3	0
Fruit trees	37	5	54	50	6	36	2	3	1	48	33	63
Crops and fruit trees	7	0	11	16	15	16	31	32	30	18	18	17
Only livestock	**36**	**77**	**13**	**5**	**3**	**8**	**1**	**3**	**0**	**1**	**1**	**0**
Mixed plants and livestock	**17**	**13**	**20**	**25**	**18**	**32**	**56**	**54**	**57**	**33**	**44**	**20**
Livestock and crops	2	5	0	7	1	13	10	7	13	11	19	1
Livestock and fruit trees	9	5	11	8	10	6	2	1	3	5	1	9
Livestock, crops, and fruit trees	6	3	9	10	7	13	44	46	41	17	24	10

Table 12: Grouping of sample farms according to income level

Income group	Income range	% of households			
	(US$)	Jordan	Lebanon	Palestine	Syria
Small	<5000	49	44	29	86
Medium	5000 - 10,000	34	36	42	10
Large	> 10,000	17	20	29	4

Table 13: Women's contribution to household income (%)

Income source	Jordan	Lebanon	Palestine	Syria
Crops	19	18.4	35	14.4
Livestock products	13	4.7	19	11
Live animals	2	1.4	7	1
Off-farm (Agriculture)	9.2	1	1	0
Off-farm (Non-agriculture)	3	3.5	25	0
Government employee	12	1	0.3	1.6
Remittances	0	0	0	0.7
Other	0	6.7	1.5	0.3

6.2 The status of agrobiodiversity

To assess the agrobiodiversity status, several indicators were developed, including crop diversity, previous crop before planting fruit trees, variety dominance, intensity of local variety, wild and local trees, changes in area of local varieties, abandoning local varieties, cropping and land topography, pesticide application, yields of local and improved varieties, and source of seeds for targeted species.

6.2.1 Crop diversity

It was expected that crop diversity would be beneficial to agrobiodiversity through growing more than one crop: a risk reduction strategy to increase the sustainability of local varieties. A crop diversity indicator was used for this purpose; when the value is > 1, crop diversity is high. The indicator was calculated by dividing the number of planted crop species by the number of plots in the farm.

The crop diversity indicator was 1.30 in Jordan, 1.11 in Lebanon, 0.96 in Palestine, and 1.12 in Syria. Crop diversity was much higher in mountainous areas such as Ajloun, Aarsal, and Al-Haffeh compared to other areas (Table 14). In mountainous areas may one field have 15 crop species such as the case of Ajloun and Al-Haffeh.

Table 14: Crop diversity indicator (no. of crops planted, divided by no. of plots per farm)

Item	Jordan			Lebanon			Palestine			Syria		
	Total	Muw-aqqar	Ajloun	Total	Aarsal	Baalbak	Total	Hebron	Jenin	Total	Sweida	Al-Haffeh
No. of plots	2.35	2.25	2.45	3.89	3.59	4.23	4.86	5.00	4.72	3.76	4.91	2.58
No. of crops	3.05	2.25	3.86	4.31	4.43	4.18	4.66	4.84	4.47	3.79	4.69	2.89
Crop diversity	1.30	1.00	1.58	1.11	1.23	0.99	0.96	0.97	0.95	1.01	0.96	1.12

6.2.2 Previous crop before planting fruit trees

The previous crops before planting fruit trees was an important indicator of substitution of fruit trees in the place of field crops or fallow, which would reduce agrobiodiversity of field crops. Tables 15-18 summarize the previous crops before planting of fruit trees in the four countries.

Table 15: Previous crop before planting fruit trees in Syria (no. of observations)

Trees planted	Previous crop								Total
	Fallow	Grape	Wheat	Barley	Tobacco	Vegetable	Wheat and barley	Wheat and chickpea	
Almond	0	0	0	0	0	0	0	1	7%
Grapes	35	0	4	2	0	0	0	13	38%
Pear	2	0	0	0	0	0	0	1	2%
Apple	39	7	2	0	0	0	14	9	50%
Olive	2	0	3	0	1	1	0	6	9%
Total no.	78	7	9	2	1	1	14	30	142
%	55%	5%	6%	1%	1%	1%	10%	21%	100%

Table 16: Previous crop before planting fruit trees in Palestine (no. of observations)

Trees	Previous crop							Total
	Stone fruit	Grapes	Wheat	Barley	Vetch	Lentil	Other crops	
Olives	2	1	8	41	2	8	1	47%
Stone fruit	3	3	4	13	0	1	3	20%
Grapes	8	5	1	13	1	0	0	21%
Apricot	1	3	0	4	0	0	0	6%
Apple	0	3	1	1	0	1	0	5%
Olive and stone fruit	0	0	0	1	0	0	0	1%
Total no.	14	15	14	73	3	10	4	133
%	11%	11%	11%	55%	3%	8%	3%	100%

Table 17: Previous crop before planting fruit trees in Lebanon (no. of observations)

Trees	Previous crop										Total
	Fallow	Apricot	Cherry	Grape	Apple	Wheat	Barley	Water-melon	Mixed vegetables & fruits	Apricot & cherry	
Apricot	3	0	0	0	1	10	1	0	1	0	17%
Cherry	3	0	0	1	1	19	0	1	0	1	28%
Almond	4	0	1	0	0	3	0	0	0	0	9%
Fig	0	0	0	0	0	0	0	0	0	0	0%
Grape	0	0	0	0	0	2	1	0	0	0	3%
Pear	0	0	0	1	0	7	0	0	0	0	9%
Apple	1	0	0	0	0	19	0	0	1	1	24%
Olive	0	0	0	0	0	0	0	0	0	0	0%
Peach	0	0	0	0	0	2	0	0	0	0	2%
Prunus mahaleb	1	0	0	0	0	0	0	0	0	0	1%
Apricot + cherry	1	0	0	0	0	0	0	0	0	0	1%
Mixed trees	1	2	0	1	0	0	0	0	0	1	5%
Total no.	14	2	1	3	2	62	2	1	2	3	92
%	15%	2%	1%	3%	2%	67%	2%	1%	2%	3%	100%

Table 18: Previous crop before planting fruit trees in Jordan (no. of observations)

Trees	Previous crop						Total
planted	Grape	Pear	Apple	Plum	Cherry	Total	
Plum	0	0	1	0	1	2	33%
Olive	1	0	0	0	0	1	17%
Grape	0	1	0	0	0	1	17%
Apple	1	0	0	0	0	1	17%
Cherry	0	0	0	1	0	1	17%
Total no.	2	1	1	1	1	6	100%
%	33%	17%	17%	17%	17%	100%	

In Syria, apple and grape were the most important trees planted by farmers; of those who planted fruit trees about 55% had planted them in fallow or newly reclaimed areas (Table 15), affecting diversity of wild species. In Palestine, olives, grapes, and stone fruit were the most important fruit trees (Table 16) replacing field crops, especially barley (55%) and wheat (11%). In Palestine 22% of farmers also planted fruit trees instead of stone fruit and grapes, with a negative effect on local species and agrobiodiversity since most were not local seedlings. Cherries and apples were the most important fruit trees planted by farmers in Lebanon (Table 17), replacing wheat (67%) and fallow (17%). Only six farmers in Jordan planted fruit trees during the survey year (Table 18) and there was no trend to plant fruit trees instead of fallow or field crops.

Generally, planting fruit trees substituted for fallow in Syria, for barley in Lebanon, and for wheat in Palestine. The situation was not clear in Jordan since the number of observations was only 6 compared to 142 observations in Syria.

6.2.3 Variety dominance

The use and dominance of a limited number of varieties is an important indicator of agrobiodiversity status. The dominant varieties and their percentages of the area planted in the study areas are summarized in Table 19. Most crop areas planted with olive, grape, barley, and wheat in Jordan were local varieties. In Lebanon, all barley, lentil and chickpea areas were local varieties; and > 85% of the fig and grape areas were landraces. In Lebanon, most areas planted with apple or apricot were new varieties. In Palestine, the majority of areas planted by olive, vetch, barley, lentil, or chickpea were local varieties; but for wheat, improved varieties predominated. In Syria, although improved varieties were disseminated in the wheat-based system, the local wheat varieties were important.

Table 19: Variety dominance in the project areas

Country	Species	Variety	Total crop area (%)	Farmers using the variety (%)
Jordan	Olive	Baladi	36	-
		Romi	27	-
		Nabali	9	-
	Grape	Zeeni	75	-
		Baladi	18	-
	Barley	Baladi	46	-
		Safey	32	-
	Wheat	Baladi	40	-
		Local	14	-
		Zogheebi	45	-
Lebanon	Apricot	Faransi	57	65
	Almond	Baladi	49	61
	Fig	Baladi	87	78
	Grape	Aabidi	86	85
	Apple	Golden	94	92
	Wheat	Salamouni	83	90
	Barley	Baladi	100	100
	Lentil	Baladi	100	100
	Chickpea	Baladi	100	100
Palestine	Olive	Romi	65	54
		Nabaly	31	42
	Wheat	White Debeya	22	31
		Areal	23	31
		Lakheesh	21	20
		Anbar	11	16
	Barley	6-rowed barley	88	89
	Vetch	Baladi	100	100
	Lentil	Baladi	100	100
	Chickpea	Baladi	20	21
		Turkey	80	79
Syria	Wheat	Hourani	45	49
		Cham	14	10
		Abosadi	12	10
		Baladi	4	5
		Tunisia	1	8
		Hriadia	2	6

- Data not available

6.2.4 Intensity of local varieties

The comparison of crop areas planted to local varieties to the area of new varieties gave a clear picture of the intensity of use of local varieties, an essential indicator of on-farm agrobiodiversity status (Table 20). The use of local varieties in Jordan reached 100% for grape and wheat; and > 90% for apricot and olives (the new olive variety was a clone from the Nabali landrace); 55% of wheat; but new varieties of apple were used and only 25% of the apple area was local varieties.

In Lebanon, local varieties dominated almond, grape, olive, wheat, barley, chickpea, and lentil areas. Farmers usually tend to new varieties of apricot, cherry, or apple. Local varieties predominated in Palestine, except for wheat. In Syria local varieties were widely used except for apple, while both local and improved olive

varieties were used. In all countries in general, intensity of local varieties was high except for some fruit trees, such as apple and cherry, suggesting that agro-biodiversity was not highly degraded in the targeted areas in terms of the number of predominant landraces. Farmers reported the disappearance of many local varieties of field crops and some fruit trees. The areas of landraces have been reduced by the expansion of fruit trees, mainly apples and cherries. Discussion with farmers indicated that 7-12 varieties of durum wheat, > 15 landraces of olive, figs, and grapes could be found in one of the mountainous areas. For barley, chickpea, and lentil, the landraces were called local varieties and might have been composed of many varieties. Farmers seldom used more than one variety of field crops but often grew many varieties of fruit trees.

Table 20: Intensity of local varieties (% of area)

Country	Species	Local variety	New variety	Mixed varieties
Jordan	Olive	90	10	0
	Apple	25	75	0
	Grape	100	0	0
	Apricot	95	5	0
	Wheat	55	45	0
	Barley	100	0	0
Lebanon	Apricot	11	70	19
	Cherry	20	71	9
	Almond	100	0	0
	Grape	100	0	0
	Apple	7	93	0
	Olive	90	10	0
	Wheat	90	10	0
	Barley	100	0	0
	Chickpea	100	0	0
	Lentil	100	0	0
Palestine	Olive	54	46	0
	Grape	100	0	0
	Apricot	77	23	0
	Wheat	17	83	0
	Barley	85	15	0
Syria	Grape	100	0	0
	Apple	3	97	0
	Olive	12	0	88
	Wheat	74	16	10
	Chickpea	100	0	0

6.2.5 Wild and local varieties of trees

One objective of the project was to conserve local varieties and their wild relatives within the national biodiversity and agricultural strategies. The households with local and/or wild trees and average tree numbers are summarized in Table 21. Many households had both local varieties and wild trees in their farm, but there were differences among countries in local and wild species. In Jordan, nearly 23% of households had wild tree species; and 27% of households had wild almond and pistachio species on the edges of their fields. The situation was even

better in Lebanon, where nearly 50% of households had wild grape, pear, almond, and apple trees in their farm, with the rest growing local varieties. In Palestine and Syria, more local varieties of fruit-trees were grown. It can be concluded that this indicator showed conservation of agrobiodiversity of wild species around fields. However, the tendency for reclaiming natural habitat for urbanization and agriculture should be monitored and regulated.

Table 21: Wild and local varieties of fruit trees

Type of trees	Cultivated local varieties		Wild species	
	% of households	Av. number of trees	% of households	Av.number of trees
Jordan				
Fig	30	16	23	4
Grape	18	279	27	26
Pear	10	292	6	131
Almond	15	90	13	68
Botom	6	6	11	22
Apple	20	598	8	148
Peach	12	22	6	29
Olive	32	397	8	156
Cherry	7	134	3	17
Apricot	9	981	4	38
Plum	11	302	4	7
Pomegranates	3	66	1	0
Forest	3	266	3	167
Lebanon				
Fig	62	21	0	0
Grape	59	94	47	2
Pear	50	13	59	21
Almond	51	14	52	60
Botom	0	0	49	14
Apple	46	5	0	0
Peach	0	0	0	0
Palestine				
Fig	39	8	1	2
Grape	41	156		
Pear	5	15	2	8
Almond	43	58	6	60
Botom	2	2	21	50
Apple	12	39		
Peach	7	28		
Other	21	137	18	59
Syria				
Fig	64	10	3	4
Grape	75	292	5	86
Pear	48	20	7	8
Almond	48	30	8	9
Botom	3	3	18	14
Apple	61	175	5	23
Peach	22	10	1	10
Craterous	3	13	15	4
Cherry	14	52	1	30
Olive	36	143	1	5

6.2.6 Changes in area of local varieties, 2000-2004

Stability of the planted area of local varieties can be an indicator of status and change in agrobiodiversity. Households were surveyed on the areas of local varieties planted between 2000 and 2004 for several crops. The analysis showed a reduction in area of local varieties in Jordan, with a large reduction of 42% for chickpea (Table 22). In Lebanon, the area of local wheat varieties decreased by 42%, barley by 16%, chickpea 21%, lentil 49%, and grapes 10%; at the same time, the area of local varieties increased 66% for apple and 145% for olive landraces. In Palestine, areas of local varieties increased for wheat by 15%, chickpea by 75%, olives 25%, and apricot 179%. However, the area of barley decreased by 75%, lentil by 36%, and grapes 17%. In Syria, the areas of landraces of chickpea increased by 44%, apple by 14%, olive 36%, and cherry 21%; the areas for wheat decreased by 40%, barley by 35%, and grapes 23%. Generally, the area planted to local varieties declined in the four participating countries for wheat and barley, while the area of local olive varieties increased. These results indicated clear substitution of field crops by fruit trees. This is evident in Lebanon where expansion in apple and olive plantations has substituted for cereal and legume crops. The same conclusion can be applied to Palestine and Syria.

Table 22: Changes in area of local varieties between 2000 and 2004 (% of area)

Species	Jordan	Lebanon	Palestine	Syria
Wheat	-0.5	-41	15	-40
Barley	-0.7	-16	-75	-35
Chickpea	-42	-21	75	44
Lentil	-	-49	-36	-
Apple	-1	66	-	14
Grape	0	-10	-17	-23
Olive	4	145	25	3
Cherry	0	0	-	21
Apricot	0	-	179	0

6.2.7 Abandoning local varieties

The abandoning of local varieties in the four countries is summarized in Table 23. Only a small number of farmers had abandoned some local varieties in the four countries (Table 23). In Jordan, for example, 6% of farmers abandoned some local wheat varieties; similarly in Syria and Palestine, only 4% and 10% of farmers abandoned some local wheat varieties, respectively. In Lebanon, however, 14-19% of households abandoned wheat, barley, and chickpea local varieties. Clearly the maintenance of local varieties occurred in rural communities, but on a more restricted area.

The main reasons for farmers abandoning local varieties in Lebanon were high production costs, a shift to high value crops such as fruit trees; and labor shortages and high wages. In Palestine, the main reasons were availability of new varieties and change to irrigated farming.

Table 23: Abandoning local varieties (% of households)

Species	Jordan	Lebanon	Palestine	Syria
Wheat	6	19	10	4
Barley	0	14	1	1
Chickpea	0	14	2	1
Lentil	0	3	1	1
Grape	0	0	-	1
Vetch	-	2	-	-
Olive	1	-	1	-

6.2.8 Cropping and land topography

Land topography is an important indicator of conservation of targeted species. The slope of land can indicate tendency to soil erosion, especially in mechanical tillage systems. Results showed > 50% of households had flat land, > 30% had medium, and about 10% had sloping land in Lebanon, Syria, and Palestine. In Jordan, farmers rated 27% of their land as flat, 60% as medium, and 13% as sloping. Farmers in all locations tend to plant trees and field crops in flat and medium land (Table 24), which is a good practice for soil conservation. However, there were cases of fruit trees planted on sloping land, which occurred for 19% of olive and 25% of almond growers in Jordan, 24% of olive growers in Palestine, and 18% of grape growers in Syria.

Table 24: Crops versus land topography (% of farms)

Crop	Land topography		
	Sloping	Medium	Flat
Jordan	**13**	**60**	**27**
Olive	19	58	23
Almond	25	75	-
Wheat	-	62	38
Barley	7	61	32
Lebanon	**9**	**39**	**52**
Grape	8	36	56
Cherry	6	42	52
Apple	3	11	86
Wheat	2	31	67
Barley	3	44	53
Chickpea	-	30	70
Palestine	**10**	**32**	**58**
Olive	24	41	34
Stone fruits	4	48	48
Wheat	8	24	67
Barley	5	26	68
Lentil	0	32	68
Chickpea	7	32	61
Syria	**8**	**39**	**53**
Grape	18	42	40
Olive	3	50	47
Apple	10	40	50
Wheat	4	36	60
Barley	4	42	53
Chickpea	5	16	79

6.2.9 Pesticide application

The intensive use of pesticides, especially herbicides, is threatening the wild relatives of crop species. Results indicate that farmers in the targeted communities did not apply pesticides intensively. Farmers' responses indicated use of herbicides on wheat and barley fields in Palestine only, with no major application of pesticides in all other target areas (Table 25).

Table 25: Pesticide application in target areas (% of farmers)

Crops	Jordan	Lebanon	Palestine	Syria
Wheat	5	2	54	2
Barley	1	0	17	0
Lentil	1	0	1	0
Chickpea	1	0	11	0
Onion	-	-	17	-
Vetch	-	-	6	-
Alfalfa	-	-	9	-

6.2.10 Yields of local and improved varieties of wheat and barley

Estimated grain yields for local and improved varieties of wheat and barley under different growing conditions in Syria, Lebanon, Jordan, and Palestine are summarized in Tables 26-29. It is notable that productivity of improved wheat varieties was generally higher than local varieties, especially in good seasons; this trend was the same in the normal and bad seasons. Some local wheat varieties had higher straw yields compared to improved varieties; this was the case for the varieties Hourani in good seasons in Syria, and Baladi in bad seasons in Jordan. This is an important research implication, that both grain and straw yield are important for livestock feeding in dry areas. Their higher straw yield may encourage farmers to continue growing and to conserve the local varieties.

Table 26: Wheat and barley yields of landraces and improved varieties under different growing conditions in Syria (kg/ha)

Variety		Grain yield			Straw yield		
		Good season	Normal season	Bad season	Good season	Normal season	Bad season
Wheat							
Hourani	Mean	1330	580	120	1080	530	110
	N	25	25	24	23	23	23
Cham 3	Mean	1800	880	200	800	600	490
	N	6	6	6	1	5	5
Abou	Mean	760	490	120	780	490	140
Saada	N	7	7	5	6	6	5
Baladi	Mean	650	400	50	500	280	60
	N	4	4	4	4	4	4
Barley							
Baladi	Mean	1510	640	100	930	450	70
	N	23	23	22	20	22	20

N = Number of observations

Table 27: Wheat and barley yields of landraces and improved varieties under different growing conditions in Lebanon (kg/ha)

Variety			Grain yield			Straw yield		
			Good season	Normal season	Bad season	Good season	Normal season	Bad season
Wheat	Salamouni	Mean	2160	1210	470	2820	1420	480
		N	58	50	38	54	47	37
	Breiji	Mean	1940	1120	680	4250	2470	1320
		N	9	9	5	8	8	5
Barley	Baladi	Mean	2610	1400	540	2300	1260	520
		N	33	26	22	30	25	22

Table 28: Wheat and barley yields of landraces and improved varieties under different growing conditions in Jordan (kg/ha)

Variety			Grain yield			Straw yield		
			Good season	Normal season	Bad season	Good season	Normal season	Bad season
Wheat	Baladi	Mean	3380	1130	750	3080	1380	1000
		N	4	2	2	3	2	1
	Zogbee	Mean	5250	1150	500	1750	1250	725
		N	2	2	2	2	2	2
	F8	Mean	800	425	300	2000	1000	700
		N	2	2	1	1	1	1
	Average	Mean	3090	940	660	2410	1460	730
		N	10	7	7	8	7	5
Barley	Baladi	Mean	1360	880	880	1240	730	350
		N	6	6	6	4	4	4
	Safey	Mean	1400	380	380	950	500	
		N	5	3	3	3	1	

Table 29: Wheat and barley yields of landraces and improved varieties under different growing conditions in Palestine (kg/ha)

Variety			Grain yield			Straw yield		
			Good season	Normal season	Bad season	Good season	Normal season	Bad season
Wheat	White Debeya	Mean	2310	1550	740	3200	2070	1170
		N	45	44	35	45	44	35
	Baladi	Mean	3480	2100	610	4840	3030	1490
		N	8	8	7	8	8	7
	Anbar Baladi	Mean	4550	2740	1040	6210	3740	1920
		N	19	19	18	19	19	19
	Black Debeya	Mean	2490	1540	720	3790	1960	1200
		N	7	7	6	7	7	6
	Areal	Mean	4210	2340	680	5950	3480	1550
		N	10	10	10	10	10	10
	Lakheesh	Mean	2340	1480	650	3300	1950	1480
		N	5	5	4	5	4	4
	Anbar Baladi	Mean	2950	1750	780	4630	2880	1380
		N	4	4	4	4	4	4
	F8 improved	Mean	3500	2100	710	5500	3460	1980
		N	12	12	11	12	12	12
Barley	6-rowed barley	Mean	1950	1290	710	2400	1730	1030
		N	26	26	22	26	26	24
	Baladi	Mean	2450	1760	880	3520	2400	1470
		N	23	23	19	23	23	19

6.2.11 Sources of seeds for targeted species

Farmer knowledge of seed production, especially for local varieties, is an important indicator in assessing agrobiodiversity of target species. Self-production of seeds conserves local varieties. Seed purchase from market or seed exchange with other farmers may have positive effects on agrobiodiversity, because it reflects opportunities to conserve local varieties. In the case of Lebanon, Palestine, and Syria, self-production of seeds was the main source of barley, wheat, and lentil seed (Table 30). The market was marginal in providing seed of these crops. However, in Jordan, farmers depend heavily on the market for seed of targeted field crops.

Table 30: Sources of seed/seedlings for targeted species

Species	Self-production	Market	Exchange
Jordan			
Barley	24	74	2
Wheat	22	78	
Olive	9	91	
Lebanon			
Barley	83	17	
Wheat	94	6	
Lentil	88	13	
Apple	6	94	
Grape	7	93	
Palestine			
Barley	69	29	2
Wheat	55	31	14
Lentil	71	9	20
Chickpea	36	64	0
Syria			
Barley	87	7	6
Wheat	70	26	4
Lentil	100		
Chickpea	81	11	8
Apple		100	

Increased demand will encourage farmers and the private sector to multiply the seeds and seedlings of local and improved varieties. The introduction of informal seed production systems and fruit tree nurseries focused on landraces will contribute substantially to conserving agrobiodiversity, since formal seed production is concentrated on improved varieties.

6.2.12 Sources of degradation and its effect on agrobiodiversity

Farmers were asked if they had degradation on their farms, its sources, and effects on agrobiodiversity (Table 31). The three major degradation factors mentioned were overgrazing, introduction of new species, and land reclamation. The source of degradation varied between locations. In Jordan, overgrazing, deforestation, and urbanization were the three main sources. Overgrazing and introduction of new species were the two main sources of degradation in Lebanon; with quarries an important threat to natural habitats in Aarsal. In Palestine, the major threats to

agrobiodiversity were overgrazing, soil erosion, introduction of new species, and urbanization in both Hebron and Jenin; however, quarries and land reclamation were sources of degradation in Hebron and Jenin, respectively. In Syria, only in Al-Haffeh were erosion, introduction of new species and urbanization the main sources of degradation.

Table 31: Sources of degradation of local agrobiodiversity (% of farmers)

	Jordan		Lebanon		Palestine		Syria	
Degradation sources	**Ajloun**	**Muwaqqar**	**Aarsal**	**Baalbak**	**Hebron**	**Jenin**	**Sweida**	**Al-Haffeh**
Overgrazing	38.7	71.4	31.5	41.5	97.1	84.3	1.4	1.4
Land reclamation	5.3	0.0	12.3	29.2	18.6	38.6	0.0	1.4
Deforestation	44.0	0.0	11.0	6.2	4.6	0.0	0.0	4.2
Erosion	28.0	30.0	6.8	6.2	75.7	32.9	9.5	26.4
Affected by new species	4.0	0.0	20.5	27.7	44.6	40.0	0.0	26.4
Affected by fire	8.0	0.0	1.4	1.5	6.2	24.3	2.7	0.0
Affected by quarries	8.0	5.7	9.6	1.5	41.4	0.0	0.0	23.6
Affected by urbanization area	54.7	4.3	1.4	6.2	89.9	91.4	0.0	23.6

Table 32: Farmers' perceptions of the effects of degradation on agrobiodiversity (% of farmers)

Source of degradation	Existence of degradation	Impact on biodiversity		
		Low	Medium	High
Jordan				
Overgrazing	55	13	33	55
New species	2	100		
Reclamation	3	100		
Deforestation	23	3		97
Erosion	29	8	38	55
Quarries	7	100		
Urbanization	30	89	11	
Lebanon				
Overgrazing	29	24	59	17
New species	17	24	71	6
Reclamation	10	40	20	40
Deforestation	9	11	44	44
Erosion	7	29	57	14
Quarries	4	25	25	50
Urbanization	3	33	67	0
Palestine				
Overgrazing	91	11	53	36
Reclamation	29	46	44	10
Erosion	54	31	64	5
New species	42	33	54	12
Quarries	21	21	59	21
Urbanization	57	42	46	12
Syria				
Overgrazing	2			100
New species	13	57	14	29
Reclamation	1		100	
Deforestation	2	50	50	
Erosion	18	67	20	13
Quarries	12		50	50
Urbanization	12	38	50	12

Farmer perceptions of the effect of degradation on agrobiodiversity are summarized in Table 32. The effects of overgrazing, deforestation, and soil erosion were high on agrobiodiversity degradation in Jordan and Lebanon, whereas the effects of all sources were classified as medium in Palestine. In Syria, overgrazing was greatly affecting agrobiodiversity, with land reclamation and urbanization of slightly lesser importance, and other degradation sources had little effect on agrobiodiversity.

6.3 The wealth index

The livelihood analyses were focused on how income sources differ between households in the participating countries; therefore, there was a need for one indicator as a comparison. The chosen indicator was the wealth index, based on the status of household assets and was used for ranking the households of a community.

In the wealth ranking, variables important in distinguishing households from each other in each community were identified by Principal Components Analysis. Previously, wealth quartiles have been used to explore patterns of income distribution in household studies from nearby Shindi Ward in Chivi (Cavendish 1999, 2002) and a study of household livelihoods in semi-arid regions (Compbel et al. 2002). A similar analysis was used to calculate wealth indices in the present study.

6.3.1 Household assets

In the dry areas and mountain regions, rural livelihoods and agriculture, including local agrobiodiversity are interlinked. A livelihood comprises the assets, activities, and access to these as mediated by institutions and social relations; together they determine the living gained by an individual or a household. The construction of a livelihood is an ongoing process with constantly changing elements, and alterations in the quality and quantity of biodiversity resources have direct implications on the livelihoods of those who depend on them. While in the short-term such changes in resources have a greater effect on the livelihoods of people .

Households usually use a variety of resources as inputs into their production processes as they attempt to meet and extend their needs. These can be classified as human, financial, physical, natural and social capitals, as has been popularized in the sustainable livelihoods approach (Carney, 1998). Five capital assets were used to ensure that all the components of the livelihood assets were addressed.

a. Natural capital

Natural capital is very important for rural communities since they derive all or part of their livelihoods from resource-based activities. For this reason it is important to consider access and quality and how both were changing.

Farm size is a major determinant of financial status of a farmer; land holdings also play an important role in family labor employment and income; production per unit area may also depend on farm size. However, the operational land holding is an important indicator of family natural resources. The total holding areas vary between countries and topography, but generally most were small farmers and only some had access to irrigation. Holding size is largest in Jordan (114 du), followed by Palestine (73 du), then Lebanon (64 du), and finally Syria (50 du) (Table 33). It should be noted that only Muwaqqar is located in a flat area. The majority of farmers had access to water, and common rangeland was more evident in Lebanon, Palestine, and Syria. Most of rangeland in Jordan, although privately owned, was accessible to herds.

b. Human capital

The livelihood analysis of the human capital was conducted because it is required to make use the four other types of capital. Human capital usually represents the skills, knowledge, ability to labor and good health that together enable people to pursue different livelihood strategies and achieve their objectives.

The household head remains the main driving force behind any household livelihood strategy. Characteristics of the household head were surveyed to understand decisions to adopt a particular livelihood strategy. Household head education, experience, and age had strong influences on decisions regarding crops, livestock management, and farm investments. Household endowments of different livelihood assets were included in the analysis, where farmers classified themselves into different welfare groups. The variables which represented household human capital in the four countries are summarized in Table 34. As key elements, only the variables of farmer age, family size and structure, education, and perception of their welfare status were included in the Principal Component Analysis. Most farmers classified themselves as moderately well-off; a small proportion classed themselves as poor or very poor.

c. Financial capital

The availability of cash or equivalent that enables people to adopt different livelihood strategies is defined as financial capital. Available stock and savings may not be cash, and is sometimes livestock in dry areas. Livestock animals are considered a stand-by asset as part of a strategy to reduce vulnerability. Alternative sources of income, especially from non-farm activities, are likely to have greater poverty reducing effect. Facilitating finance to farmers and intermediary agencies is important in improving livelihoods in rural areas, by improving the delivery of inputs to farmers and introducing liquidity into output marketing. Moreover, delivery of credit can be linked to savings as the other important element in rural finance.

Table 33: Households' natural capital

Natural assets	Jordan	Lebanon	Palestine	Syria
Total holding area (Du)	114	64	73	49.5
Area planted with trees (Du)	105	19	11	16.6
Irrigated area (Du)	10.2	4	0.2	0.4
Area of non-arable land (Du)	7.5	8	20	7.1
Having water resource (%)	95.9	81.2	97	52
Availability of common rangeland around the village (%)	18.3	73.9	70	71

Table 34: Households' human capital

Human assets	Jordan	Lebanon	Palestine	Syria
Farmer age (years)	51	51	55	51
Family size (head)	7	8	11	8
Household had one member at least (16-59 years) not resident on the farm(%)	7.6	22.5	7	26
Members of the household who have studied or are studying at an agric school (%)	12.4	0.7	4.3	7.5
Member(s) of the household with a university degree (%)	55.2	19.6	47.9	28.8
Having work opportunities outside the area (%)	22.8	13.7	19.3	38.1
Availability of wage labor when needed (%)	58.6	87.0	90.7	74.1
Household head's education (%)				
Illiterate	17.2	21.0	10.2	15.0
Read and write	6.2	28.3	10.9	7.1
Elementary	20.7	22.5	33.3	26.4
Preparatory	13.1	11.6	23.1	13.6
Secondary	24.1	8.7	13.6	19.3
University	18.6	8.0	8.8	18.6
Classification of the livelihoods of the households based on farmers' perception (%)				
Very poor	4.1	5.1	2.2	5.3
Poor	13.1	17.6	18.7	18.8
Moderately well-off	53.8	64.7	68.3	65.4
Well-off	29.0	12.5	10.8	10.5

Table 35: Households' financial capital

Financial assets	Jordan	Lebanon	Palestine	Syria
Saving money last year (%)	5.5	8.7	29.3	5.5
Having access to credit source (%)	27.6	42.8	25.0	61.7
Average annual income (US$)	6896	7120	8905	2919
Income sources (%)				
Off-farm income	65.3	48.0	51	44.5
On-farm income	34.7	52.0	49	55.5
• Crop production	3.7	8.7	26	8.6
• Fruit tree production	16.4	33.0	11	38.2
• Livestock production	14.6	8.8	13	7.2

Financial assets available to the households in the target areas are shown in Table 35. The percentage of households who saved money in the previous year was notably low. Farmer access to credit was low, except in Syria; and income from non-farm activities was about half of household income. Cash saving was only important in Palestine. Average annual household income was highest in Palestine > Lebanon > Jordan > Syria. Off-farm income was the major source (65%) of household income in Jordan, whereas, on-farm income from fruit trees was the main contribution in Lebanon and Syria.

d. Social capital

The social capital of any society is very important, as mutual trust and connectedness helps to cope with shocks and vulnerability, particularly for the poor. However, in this study, due to availability of agricultural cooperatives, farmers had potential to cooperate in commonly beneficial development schemes. There is a strong need to develop mutual trusts and organization of the community to develop and utilize the available resources for sustainable livelihoods. The types of social capital available to households and used in the factor analysis are shown in Table 36. Most farmers indicated the availability of agricultural cooperatives in their communities, however, only in Syria and to a lesser extent in Jordan, were farmers members of these cooperatives.

e. Physical capital

Physical capital includes basic infrastructure as well as producer goods supporting livelihoods. Many poverty assessments have found that a lack of particular infrastructure is a core dimension of poverty. Without adequate access to public services such as water and energy, human health deteriorates and long periods were spent in non-productive activities (DFID, 2001). Livestock, tractor, pick-up, and tree ownership all affect household welfare; these physical assets were available to some households (Table 37). The supply of electricity and telephone availability was satisfactory in the four countries.

Table 36: Households' social capital (% of households surveyed)

Social assets (%)	Jordan	Lebanon	Palestine	Syria
Having a cooperative in the village	52.4	64.2	61.9	94.5
Cooperative membership	26.2	19.6	12.9	65.3
People generally trust a person in the village on issues related to loans and credit	33.1	42.8	59.3	19.0
Level of trust has become better over the last few years (%)				
No answer	-	-	-	35.4
Better	15.9	17.0	9.3	6.1
The same	26.9	24.4	21.4	24.5
Worse	57.2	58.5	69.3	34.0

Table 37: Household physical capital

Physical assets (%)	Jordan	Lebanon	Palestine	Syria
Having land planted with trees	93.1	87.0	72	87
Having an owned tractor	3.4	18.8	24	13.6
Having an owned car	20.7	18.8	25	4.1
Having a pick-up	21.4	36.2	5	10.9
Having sheep	22.8	19.6	47	14
Having cows	3.4	4.3	22	20
Having goats	35.2	27.5	1	12
Having bee hives	2.1	11.6	8	8.8
Availability of public clinic	94.5	67.9	96.4	62.6
Household benefits from public clinic services	94.5	62.7	90.7	53.7
Availability of a telephone in the house	82.1	80.4	67.9	74.1
Availability of electricity in the house	95.2	97.1	97.1	100.0

6.3.2 Calculating wealth index

The wealth index was created using Factor Analysis, a statistical technique similar to Principal Components Analysis. These analyses have the common objective of reducing the relationships between many interrelated variables to a small number of factors. However, the primary purpose of factor analysis is to describe the relationships among the many variables in terms of a few underlying but unobservable factors; several original variables are combined into a few derived variables. In factor analysis, sets of variables were grouped by their correlations, thus each group represents a single underlying construct or factor. Although factor analysis can assist in identifying underlying factors, the method is subjective: the factors must be interpreted and this relies on previous knowledge and intuition about the underlying relationships

Five main elements were hypothesized to represent household well-being; the human, natural, financial, physical, and social capitals presented in the previous section. Several variables were selected and used to represent each element, but these variables differed between countries (Table 38).

Table 38: Sets of variables included in the factor analysis to create the wealth index for each country

	Jordan	Lebanon	Palestine	Syria
Number of males 16-59 years resident on the farm	✓			
Number of females 16-59 years resident on the farm	✓		✓	
Total holding area	✓			✓
Rented area	✓	✓	✓	
Sheep numbers	✓	✓	✓	
Pick-up ownership	✓	✓		
Experience in agriculture	✓			
Area of non-arable land	✓			✓
Off-farm income (%)	✓		✓	✓
Level of trust in the village	✓	✓		✓
Goat numbers	✓			
Cow numbers	✓	✓		✓
Number of rooms in the house		✓		✓
Bee hive numbers		✓		
Availability of a telephone in the house		✓	✓	✓
Farmer's age		✓		
Owned area		✓	✓	
Having a satellite dish and T.V.		✓		
Having work opportunities outside the area		✓	✓	
Farmer's education			✓	✓
Car ownership				✓
Water resource availability				✓
Tractor ownership			✓	
Total value of shops			✓	
Any member of the household having a university degree			✓	
Family size			✓	
Agree with the statement that "people here look out mainly for the welfare of their own families"			✓	

In calculating the wealth index, the coefficients of variables estimated by factor analysis were multiplied by standardized values of the respective variables for each factor (Xi). Household-specific wealth indices were constructed from scores obtained from factor analysis, according to:

$$X^* = w_1X_1 + w_2X_2 + w_3X_3 + \ldots + w_nX_n$$

where X^* = score for each household

X_i = value of factor i and has mean = 0, standard deviation = 1

w_i = weight, which is specified for the maximum variance of factor i

6.3.3 Wealth quartiles by target area

In order to use indices for assessing welfare status, wealth index, which was calculated based on factor analysis, was used to sort wealth categories and classify households into four welfare quartiles. The distribution of households among wealth quartiles differed between target areas (Table 39). For example, most farmers in Sweida – but only 8% of farmers in Al-Haffa – were in the highest wealth quartile. The characteristics of households in a given wealth quartile were also different. In Syria, there were differences in wealth indicators between wealth quartiles (Table 40), the highest quartile had more land, the contribution of income from off-farm activity was higher, education level was higher, and there was more trust among this group compared to other groups.

Table 39: Wealth quartiles by target area (% of households)

Countries and target areas		Wealth quartiles				Total (%)
		Lowest 25%	25-50%	50-75%	Highest 25%	
Syria	Sweida	17.3	25.3	17.3	40.0	100.0
	Al-Haffeh	31.9	26.4	33.3	8.3	100.0
Palestine	Hebron	32.9	10.0	24.3	32.9	100.0
	Jenin	17.1	38.6	27.1	17.1	100.0
Lebanon	Aarsal	20.5	32.9	28.8	17.8	100.0
	Baalbak	29.2	16.9	20.0	33.8	100.0
Jordan	Ajloun	41.3	29.3	16.0	13.3	100.0
	Mwaqqar	8.6	20.0	32.9	38.6	100.0

Table 40: Some characteristics of households by wealth quartile

Indicators	Wealth quartiles				Average
	Lowest 25%	25-50%	50-75%	Highest 25%	
Jordan					
Total holding area (Du)	29	57	74	292	114
Area of non-arable land (Du)	2	4	2	21	8
Off-farm income (%)	68.2	64.6	71.1	57.4	65.3
No. of rooms in the house	4.9	4.4	4.7	5.6	4.9
Water resource availability (%)	86.5	97.2	100.0	100.0	95.9
Telephone in the house (%)	78.4	83.3	77.1	89.2	82.1
People generally trust one another in the village (%)	56.8	27.8	14.3	32.4	33.1
Farmer education (%)					
Illiterate	2.7	16.7	22.9	27.0	17.2

Table 40: (Continued)

Indicators	Wealth quartiles				Average
	Lowest 25%	25-50%	50-75%	Highest 25%	
Read and write	5.4	8.3	2.9	8.1	6.2
Elementary	2.7	13.9	37.1	29.7	20.7
Preparatory	18.9	19.4	2.9	10.8	13.1
Secondary	37.8	19.4	20.0	18.9	24.1
University	32.4	22.2	14.3	5.4	18.6
Lebanon					
Total holding area (Du)	24.4	51.6	73.2	104.3	63.6
Area of non-arable land (Du)	1.5	5.2	6.3	18.3	7.9
Off-farm income (%)	40.7	53.9	58.5	38.9	48.0
No. of rooms in the house	4.2	4.8	5.8	5.7	5.1
Water resource availability (%)	82.4	74.3	82.4	85.7	81.2
Telephone in the house (%)	11.8	11.4	23.5	31.4	19.6
People generally trust one another in the village (%)	50.0	42.9	47.1	31.4	42.8
Farmer education (%)					
Illiterate	2.9	17.1	29.4	34.3	21.0
Read and write	17.6	22.9	41.2	31.4	28.3
Elementary	20.6	25.7	17.6	25.7	22.5
Preparatory	17.6	17.1	5.9	5.7	11.6
Secondary	20.6	11.4		2.9	8.7
University	20.6	5.7	5.9		8.0
Syria					
Total holding area (Du)	17	39	36	106	50
Area of non-arable land (Du)	2	3	7	18	7
Off-farm income (%)	28	41	56	53	44
No. of rooms in the house	3	4	4	6	4
Water resource availability (%)	63.9	52.6	64.9	27.8	52.4
Telephone in the house (%)	44.4	76.3	83.8	91.7	74.1
People generally trust one another in the village (%)	11.1	15.8	24.3	25.0	19.0
Farmer education (%)					
Illiterate	38.9	2.6	-	-	10.2
Read and write	30.6	10.5	2.7	-	10.9
Elementary	27.8	60.5	27.0	16.7	33.3
Preparatory	2.8	26.3	40.5	22.2	23.1
Secondary	-	-	24.3	30.6	13.6
University	-	-	5.4	30.6	8.8
Palestine					
Total holding area (Du)	29	39	57	168	73
Area of non-arable land (Du)	5	3	13	60	20
Off-farm income (%)	42	50	64	48	51
No. of rooms in the house	4.0	5.2	5.0	5.3	4.9
Water resource availability (%)	97.1	100.0	97.2	94.3	97.1
Telephone in the house (%)	45.7	61.8	83.3	80.0	67.9
People generally trust one another in the village (%)	45.7	50.0	63.9	77.1	59.3
Farmer education (%)					
Illiterate	20.0	8.8	19.4	11.4	15.0
Read and write	8.6	5.9	2.8	11.4	7.1
Elementary	25.7	29.4	22.2	28.6	26.4
Preparatory	8.6	20.6	11.1	14.3	13.6
Secondary	20.0	8.8	25.0	22.9	19.3
University	17.1	26.5	19.4	11.4	18.6

6.3.4 Household distribution by wealth group

The distribution of participants in the project according to wealth quartiles is summarized in Table 41. The project collaborated with all types of farmers including poor, moderate, and better-off households.

Table 41: Distribution of participant farmers by wealth quartile (%)

Wealth quartile	Jordan	Lebanon	Palestine	Syria
Lowest 25%	44	25	21	24
25-50%	27	28	26	20
50-75%	11	22	22	27
Highest 25%	18	25	31	28

6.3.5 Importance of targeted species by wealth group

The importance of target species was different among farmers according to wealth groups (Table 42). Fruit trees were generally more important for all farmers compared to field crops. Apricot and apple were more important to poor farmers, while wheat and barley were more important for better-off farmers, when considering contribution to income from marketing. Generally, fruits were marketed and most harvested field crops were used for home and farm consumption and were therefore important in providing food and feed for all farmers.

Table 42: Importance of targeted species by wealth quartiles (% of households)

Species	Lowest 25 %	25-50 %	50-75 %	Highest 25 %	All groups
Lebanon					
Grapes	6	9	13	6	8
Apricot	19	28	25	16	22
Apple	15	5	3	7	7
Olive		3	3	2	2
Wheat	5	7	14	9	9
Barley	3	6	6	11	7
Chickpea	3	6	5	7	5
Lentil	2	2		1	1
Syria					
Grapes	16	17	9	22	17
Apple	12	11	8	25	15
Olive	8	11	10	8	9
Wheat	15	19	27	16	19
Barley	7	6	8	2	5
Chickpea	7	13	14	15	13
Palestine					
Grapes	11	12	11	9	11
Apple	3	-	-	-	1
Olive	31	24	19	37	28
Wheat	23	38	28	37	31
Barley	-	-	6	3	2
Chickpea	6	-	-	3	2
Onion	3	9	11	-	6

6.3.6 Effect of degradation by wealth quartiles

Table 43 summarizes the effect of degradation by wealth quartiles and countries. In Lebanon, poor households were affected by overgrazing, introduction of new species, and land erosion more than other households in other quartiles.

Table 43. Effect of degradation by wealth quartile (%)

Degradation	Wealth quartiles				Average
	Lowest 25%	25 - 50%	50 - 75%	Highest 25%	
Syria					
Affected by erosion	19.4	13.2	27.0	11.4	17.8
Affected by new species	13.9	15.8	18.9	2.9	13.0
Affected by quarries	22.2	7.9	5.4	11.4	11.6
Affected by urbanization	2.8	21.1	19.4	2.9	11.7
Jordan					
Affected by overgrazing	62.2	44.4	37.1	37.8	45.5
Affected by deforestation	32.4	27.8	17.1	13.5	22.8
Affected by erosion	21.6	33.3	40.0	21.6	29.0
Affected by urbanization	45.9	41.7	17.1	16.2	30.3
Lebanon					
Affected by overgrazing	20.6	8.6	5.9	11.4	11.6
Affected by new species	26.5	22.9	23.5	22.9	23.9
Affected by land reclamation	32.4	20.0	8.8	20.0	20.3
Palestine					
Affected by overgrazing	91.4	88.2	91.7	91.4	90.7
Affected by erosion	48.6	44.1	55.6	68.6	54.3
Affected by new species	45.7	35.3	50.0	31.4	40.7
Affected by land reclamation	28.6	32.4	25.0	28.6	28.6
Affected by quarries	37.1	5.9	19.4	20.0	20.7
Affected by urbanization	60.0	47.1	63.9	51.4	55.7

6.3.7 Land use

Farmers planted many crops and trees in the target areas (Figure 1). In all countries, wheat and barley were generally the most important cereal crops in terms of area, chickpea and lentil as food legume crops, and olive and grapes as fruit trees. In addition to these crops and trees, other fruit trees were available in Lebanon such as cherry, apricot, apple, and almond; in Syria, apple was very important, especially in Sweida; and in Palestine, apricot, apple, and stone fruits were important, onion was also important with 5% of cultivated area. Fallow land was very limited in most countries, except Lebanon where the fallow was 23% of cultivated area.

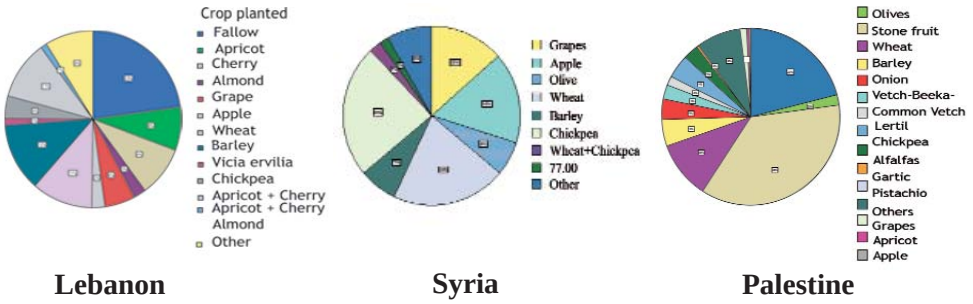

Figure 1: Land use in the study areas in Syria, Lebanon, and Palestinian Authority

6.3.8 Livelihood strategies by wealth group

a. Sources of household income by wealth quartiles

Household income from all sources is summarized in Figure 2. The income from all sources increased, proceeding from lower to upper quartiles. Percentage of income from crop production and off-farm labor wages from agriculture were generally higher in the lowest quartile compared to other groups.

Figure 2: Income sources by wealth quartile

b. Livelihood typologies

Livelihood strategies were diverse (Ellis 1998), influenced by linkages in and outside agriculture (Bebbington 1999; de Haan 2000; Reardon et al. 1992), and family characteristics such as age, education, and household size (Kusterer 1989; Valdivia 2001). The degree of diversification of the household portfolio is determined by these characteristics, and by household and individual objectives, such as risk management practices, and/or strategies available to cope with shocks. In areas of greater risk, household strategies were expected to be more diversified to minimize possible shocks from negative climate events, especially when management strategies are limited (Dunn et al. 1996). Livelihood strategies can be a useful and quantifiable concept, especially when exploring land and soil conservation measures (Hans et al. 2003). Conservation practices and investments must be appropriate for the production system, agroecological conditions, and the livelihood strategy. The livelihood strategy framework could be useful in formulation and targeting of policy.

Access, control, and management of farm resources (including water, land, livestock, crops, and knowledge) shape the choice of which activities are pursued, which goods produced, and allow households to retain the benefits of their labor. Access and control of resources and capitals, and the relation between access and control of assets allow individuals to negotiate livelihood strategies and improve their well being in rural areas (Valdivia and Gilles 2001). When access is limited or opportunistic, due to lack of institutions supporting access by individuals, the ability to sustain natural resources and other human assets is endangered.

Overall, household incomes in the study areas depend on many sources.. The main sources for households in the lowest quartile in the four countries were crop production, followed by off-farm labor, and government employment (Table 44).

Table 44: Main sources of household income in the four countries

Wealth group	Jordan	Lebanon	Palestine	Syria
Lowest 25%	Govt employ Crops Off-farm labor	Crops Off-farm labor Govt employment	Off-farm labor Crops Govt employ	Crops Govt employ Off-farm labor
25-50%	Govt employ Crops Off-farm labor	Off-farm labor Crops Govt employ	Crops Govt employ Off-farm labor	Crops Govt employ Off-farm labor
50-75%	Govt employ Crops Live animals Livestock products	Off-farm labor Crops Govt employ	Live animals Crops Govt employ	Crops Govt employ Off-farm labor
Highest 25%	Govt employ Livestock products Live animals Crops	Off-farm labor Crops Others Live animals	Live animals Off-farm labor Crops Livestock products	Crops Govt employ Others Livestock products Live animals

The highest welfare quartile included those farmers relatively more dependent on livestock products and live animals, in addition to crop production, off-farm labor, and government employment. However, the lowest quartiles were relatively more dependent on livestock compared to those in higher quartiles.

6.4 Farmers' opinions on the agrobiodiversity project and the technologies introduced

Farmers' opinion on a research and development project in their communities is an important factor. Farmer perceptions and attitudes toward a project or a technology could help or prevent adoption. To measure farmer opinion of the agrobiodiversity project, two indicators were used: farmer perception of project performance, and the components introduced by the project and used by farmers.

6.4.1 Farmers' perceptions of performance of the agrobiodiversity project

Farmers in the present survey were asked to evaluate performance of the project using a five-statement scale: very good, good, average, poor, and very poor. Many farmers reported that they had no idea, since they did not participate in the project, however, the majority rated the performance as good or very good (Table 45).

Table 45: Farmers' opinions on the performance of the agrobiodiversity project (% of farmers) who have an idea of the project).

Performance	Jordan	Lebanon	Palestine	Syria	Average
			Have an idea of the project		
Very good	46	34	14	11	26
Good	30	34	43	44	38
Average	14	28	28	32	25
Poor	8	4	11	11	9
Very poor	2	0	4	2	2
			Do not have an idea of the project		
Do not know	64	50	19	19	38

6.4.2 Components introduced by the project and used by farmers

Households who participated in the project were asked to indicate which technologies were introduced by the project and used by them (Table 46). In Palestine, 100% of participating households started to use at least one technology. The corresponding percentages were 72% in Jordan, 50% in Lebanon, and 48% in Syria.

There were differences among the four countries in acceptance of technologies introduced and tested through the project. For example, water harvesting, nurseries for fruit trees, medicinal plants cultivation, and dairy product processing were most used in Jordan. Apiculture, jam making, nurseries for pasture, and water harvesting for fruit trees were dominant in Lebanon.

Table 46: Percentage of households who participated and used technologies introduced through the project (%)

Components introduced	Jordan	Lebanon	Palestine	Syria
Not used	28.1	50.0	0.0	52.7
Water harvesting for fruit trees	19.3	6.7	8.2	6.8
Water harvesting for rangelands	0.0	3.3	5.9	4.1
Improved seed	5.3	3.3	84.7	6.8
Organic farming	0.0	3.3	18.8	4.1
Nurseries for fruit trees - seedlings	14.0	3.3	2.4	14.9
Nurseries for pastures - seedlings	5.3	11.7	5.9	0.0
Apiculture	0.0	15.0	11.8	18.9
Jam making	3.5	13.3	12.9	6.8
Dairy products processing	7.0	1.7	3.5	4.1
Mushroom farming	1.8	0.0	0.0	0.0
Medicinal plants	7.0	0.0	17.6	4.1
Reforestation	0.0	3.3	2.4	0.0
Home gardens	3.5	0.0	9.4	2.7
Feed blocks	0.0	3.3	1.2	0.0
Field gene banks	3.5	0.0	2.4	0.0
Rangeland rehabilitation	0.0	3.3	3.5	0.0
Others	1.8	1.7	2.4	1.4
Total	100.0	123.3	192.9	127.0

The total is more than 100% because some farmers used more than one technology

Wealth groups were used to estimate percentages of households using the technologies introduced and tested through the project (Table 47). It was clear that, among participating households, adoption was highest in the lowest quartile group, especially in Lebanon and Syria. This indicated that the technologies introduced by the project were appropriate for the poor.

Table 47: Use of technology tested through the project, classified by participation in the project and by wealth group (% of households)

Participation	Wealth	Jordan		Lebanon		Syria		Palestine	
in the project	quartiles	Yes	No	Yes	No	Yes	No	Yes	No
Yes	Lowest 25%	75	25	67	33	56	44	100	0
	25-50%	80	20	53	47	40	60	100	0
	50-75%	83	17	38	62	45	55	100	0
	Highest 25%	50	50	40	60	48	52	100	0
	Total	72	28	50	50	47	53	100	0
No	Lowest 25%	15	85	11	89	17	83	35	65
	25-50%	19	81	0	100	9	91	17	83
	50-75%	7	93	5	95	12	88	24	76
	Highest 25%	0	100	5	95	0	100	33	67
	Total	9	91	5	95	10	90	27	73

7. Assessment of the Impacts of the Project on Household Income and Livelihoods

The impact assessments aimed to identify the contribution of enterprises to development and conservation, and any tensions between their development, conservation and commercial objectives.

Previous assessments of the project impacts were very encouraging, and prompted new agrobiodiversity programs in research institutions in Jordan, Lebanon, and Syria; and the creation of agrobiodiversity units in the Ministry of Agriculture in Palestine, and the Forestry Department in Jordan. There has been a swift shift toward the use of wild relatives of fruit trees in afforestation efforts. In Syria, 500 000 seedlings of several wild fruit trees species have been planted since 2003, compared to a total of 230 000 in 1999, mainly wild pistachio and Quercus spp. Awareness has increased at all levels of the need to conserve agrobiodiversity. This has facilitated collaboration with tourism and education ministries, and with other projects and NGOs. Sites rich in agrobiodiversity have been identified and their management plans developed and presented to governments after their approval by local communities. Many accessions of target species have been collected and placed in national genebanks. Protocols for ecogeographic/botanic survey database management were set and policy frameworks have been was developed and shared.

However, the project impact assessment explored a wide variety of changes or trends on financial and livelihood impact, therefore the impact assessment must be considered differently to conventional project reviews in two ways: (1) it assessed impacts on broad economic and livelihood change, not of pre-defined project objectives and plans. It sought to identify overall contribution to development, not to assess only accomplishment of planned activities for internal management purposes. Given the broad undefined objectives of contributing to conservation and development, the review was focused at goal or purpose level, rather than activities and outputs. Changes in livelihoods were a key measure of impact; (2) assessment of commercial viability was integral, because these projects were enterprises, so viability will determine sustainability. The commercial assessment was a complement to, rather than a component of, the analysis of local economic and livelihood impacts.

The project reviews have an explicit focus on livelihood impacts, because this contrasts with conventional approaches in conservation and development. Generation of cash income is the way in which development projects were expected to create incentives for conservation and sustainable use of natural resources.

Other approaches might focus on sector-specific outputs, such as biomass and wildlife populations. A focus on livelihoods was emphasized as an appropriate measure of what the project means to local people, and so the likely contribution to development and conservation. This was grounded in greater understanding of poverty, such as the importance of assets, diversified portfolios of activities, and the variety of outcomes pursued by the poor.

The impact assessments in this study explored changes and trends caused by the project on the households in the target areas, and analyzed their financial and livelihood impact. Of participating households, comparisons of income from agriculture, by type of participation and wealth quartiles, with those who had not participated, were carried out (Table 23A; see Appendix). Participants in the project were classified into three groups: those who participated in activities related to agrobiodiversity enhancement; those who participated in activities related to generating value-added activities; and those who participated in the field days or training activities.

Increasing the average income from agriculture does not necessarily affect all groups of farmers especially the poor, therefore, other factors related to equality had to be considered. There are several ways to express income inequality in a society; the Gini coefficient is such a measure. The Gini coefficient is a number between 0 and 1, where 0 corresponds with perfect equality (everyone has the same income) and 1 corresponds with perfect inequality (one person has all the income, and everyone else has zero income). The Gini coefficient is often calculated with the more practical Brown Formula below:

$$G = |1 - \sum_{k=0}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k)|$$

where: G is the Gini coefficient, X is the cumulative proportion of the population variable, and Y is the cumulative proportion of the income variable.

The analysis of agricultural income of the total sample indicated that average household income for those who participated in the project was higher than for those who did not; but the differences in Gini coefficients were not significant. In the comparison between households which participated in agrobiodiversity enhancement and those which did not, there were differences in their annual income (Table 48). There was a marked increase in annual household income in households that participated in the project, showing project impact on rural livelihood. The estimated annual increase, on average, was US$1616 per household in the four countries. It ranged from US$1148 in Syria to US$1914 in Lebanon (Table 48).

Table 48: Comparison between average household income from agriculture for participants in agrobiodiversity enhancement activities and non-participants, categorized by wealth quartiles (US$/household)

Groups	Wealth quartiles	Jordan	Lebanon	Palestine	Syria	Average
Participation in Agrobiodiversity enhancement	Lowest 25%	1923	4527	2765	1056	
	25-50%	1274	3167	2765	2071	
	50-75%	5070	3973	3105	1207	
	Highest 25%	11186	6195	6266	4265	
	Total	4280	4298	3897	2487	
	Gini coeff.	0.591	0.401	0.463	0.477	
Non-participants	Lowest 25%	1473	2670	2125	1069	
	25-50%	2103	2179	5390	954	
	50-75%	2399	1460	3286	976	
	Highest 25%	3577	3268	15295	2663	
	Total	2526	2384	5351	1339	
	Gini coeff.	0.438	0.391	0.559	0.476	
Difference in household income between participants and non-participants	Lowest 25%	450	1857	640	-	982
	25-50%	-	988	-	1117	1053
	50-75%	2671	2513	-	230	1805
	Highest 25%	7609	2927	-	1602	4046
	Total	1754	1914	-	1148	1606

- no increase

8. Conclusions and Recommendations

The ways people make a living, and the constraints and opportunities they face can strongly affect the status and management of resources including agrobiodiversity. Livelihood strategies in the dry areas are dynamic, particularly due to uncertainty in agriculture caused by the variation in rainfall amount and distribution, prices and other factors. Therefore people engage in different livelihood activities and always seek supplemental income. Agrobiodiversity conservation faces a great challenge in the dry areas, as sustainable livelihoods with long-term environmental and economic benefits are uncertain. Farmers in the dry areas face environmental and socioeconomic conditions that tend to create poverty.

The present study implemented the livelihood conceptual framework to analyze data from 570 rural households in Jordan, Lebanon, Syria, and Palestine. Households were grouped into four welfare quartiles using Principal Components Analysis, based on household assets.

The analysis indicated that farm resources including water, land, livestock, agrobiodiversity, crops, and knowledge were essential resources and assets in generating the livelihoods of families in the target areas. Although agriculture was not always the main source of household income, it was a major component in the dry areas. Access, control, and management of farm resources determine which activities are pursued. When access is limited or opportunistic, due to lack of institutions supporting access, the ability to sustain natural resources and other human assets is endangered.

The average income from agrobiodiversity for those who participated in the project was higher than those who did not. If the comparison focused on the differences between the participant households in agrobiodiversity enhancement and the non-participants, the estimated increase in household income can be attributed to the project. The estimated average annual increases were US$1616 per household in the four countries, with a range of US$1148 in Syria to US$1914 in Lebanon. It is recommended for agrobiodiversity conservation and sustainable use for food and agriculture to apply the following:

a) At the local level

- Support on-farm conservation of agrobiodiversity with appropriate incentives.
- Support farmer-to-farmer seed exchange where effective, including seed fairs and community seed banks.
- Enhance local level seed production by providing technical back-stopping and business advice.
- Promote integrated crop management.

- Commit to continuing natural resources research on agrobiodiversity.
- Support local community organizations that strengthen farmers' voices on agrobiodiversity issues.
- Promote income-generating projects that use agrobiodiversity.
- Strengthen local level capacity for agrobiodiversity management and use, including tools such as farmer field schools.
- Invest in developing local markets for biodiversity-friendly agricultural products.

b) At the national level

- Support mainstreaming and better coordination of national genetic resources policies and programs, including wider stakeholder involvement in planning and implementation, and capacity building for national policy makers.
- Support the decentralization of agricultural research and extension services to work on agrobiodiversity.
- Develop policies that empower local communities to conserve agrobiodiversity.
- Promote use of native species in reforestation and landscape management.

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Appendix

Table 1A: Household assets

	Jordan		Lebanon		Palestine		Syria	
	Ajloun	Muwaqqar	Aarsal	Baalbak	Hebron	Jenin	Sweida	Al-Haffeh
Natural assets								
Number of plots	2	2	7	8	6	5	9	3
Total holding area (Du)	57	175	63	64	88	59	88	9
Owned area (Du)	44	74	56	54	74	33	80	8
Rented area (Du)	9	67	3	4	3	16	5	0
Sharecropped area (Du)	4	34	3	4	10	7	4	1
Area of arable land (Du)	40	173	59	52	53	53	71	9
Area planted with trees (Du)	45	169	25	12	9	14	25	8
Irrigated area (Du)	16	3	3	4	1	0	1	0
Area of non-arable land (Du)	12	3	5	11	35	6	13	1
Having water resource (%)	92	100	74	89.2	99	96	7	100
Availability of common rangeland around the village (%)	13.8	22.1	65.8	83.1	90	50	74	50%
Human assets								
Farmer age (yrs)	49	53	51	52	57	53	48	53
Experience in agriculture (yrs)	21	29	28	26	33	27	24	25
Family size	7	9	9	7	13	9	8	8
Number of males 8-15 yrs resident on the farm	1	1	1	1	1	1	1	0
Number of females 8-15 yrs resident on the farm	1	1	1	1	1	1	1	0
Number of males 16-59 yrs resident on the farm	2	3	3	2	3	3	2	4
Number of females 16-59 yrs resident on the farm	1	3	3	2	3	2	3	3
Household had one member at least (16-59 yrs) not resident on the farm (%)	13.3	1.4	26.0	19.5	3.0	11.0	31.0	21.0
Members of the household who have studied or are studying in agriculture school (%)	22.7	1.4	0.0	1.5	1.4	7.1	12.2	2.8
Member(s) of the household have a university degree (%)	57.3	52.9	24.7	13.8	47.1	48.6	25.7	31.9
Having work opportunities outside the area (%)	30.7	14.3	13.7	26.2	5.7	32.9	32.0	44.4
Availability of wage labor when needed (%)	92.0	22.9	94.5	78.5	85.7	95.7	85.3	62.5
Education of household head (%)								
Illiterate	2.7	32.9	13.7	29.2	20.0	10.0	6.7	13.9
Read and write	5.3	7.1	31.5	24.6	5.7	8.6	10.7	11.1
Elementary	13.3	28.6	27.4	16.9	30.0	22.9	36.0	30.6
Preparatory	16.0	10.0	15.1	7.7	8.6	18.6	20.0	26.4
Secondary	28.0	20.0	5.5	12.3	20.0	18.6	13.3	13.9
University	34.7	1.4	6.8	9.2	15.7	21.4	13.3	4.2
Classification of livelihoods of the household from their perspective (%)								
Very poor	4.0	4.3	4.2	6.2	2.9	1.4	2.7	8.6
Poor	10.7	15.7	12.7	23.1	14.5	22.9	21.3	15.5
Moderately well-off	41.3	67.1	74.6	53.8	76.8	60.0	65.3	65.5
Well-off	44.0	12.9	8.5	16.9	5.8	15.7	10.7	10.3
Financial assets								
Saved money last year (%)	9.3	1.4	8.2	9.2	34.3	24.3	6.8	4.2
Had access to credit (%)	26.7	28.6	57.5	26.2	0.0	50.0	54.1	66.7
Average annual income	3885	5836	10789 411	1055574 2	9070	8742	183508	107319
Average expenditure	1487	2969	10200 671	6415577	9187	11942	180089	170995

Table 1A: (Continued)

	Jordan		Lebanon		Palestine		Syria	
	Ajloun	Muwaqqar	Aarsal	Baalbak	Hebron	Jenin	Sweida	Al-Haffeh
Income sources (%)								
Off-farm income	63.2	67.5	58.6	36	59	43	43.2	45.8
On-farm income	36.8	32.5	41.4	64	41	57	56.8	54.2
Crop production	4.2	3	4.6	14.7	18	33	12.6	4.7
Fruit tree production	25.2	2.4	30.7	32.9	10	13	30.5	45.8
Livestock production	7.4	27.1	4.9	14.5	13	13	11.4	3
Social assets (%)								
Having cooperative in the village	70.7	32.9	81.9	44.6	57.1	66.7	97.3	91.7
Cooperative membership	38.7	12.9	19.2	20.0	7.1	18.6	85.3	44.4
People generally trust a person in the village in issue related to loans and credit (%)	40.0	25.7	42.5	43.1	60.0	58.6	21.3	16.7
Level of trust hasimproved over the last few years (%)								
No answer							69.3	0.0
Better	28.0	2.9	16.4	17.7	12.9	9.3	4.0	8.3
The same	32.0	21.4	28.8	19.4	18.6	21.4	9.3	40.3
Worse	40.0	75.7	54.8	62.9	68.6	69.3	17.3	51.4
Which would you prefer (%)								
Own and farm 10 ha of land entirely by themselves	81.3	94.3	69.9	64.6	85.7	85.7	73.3	91.7
Own and farm 25 ha of land jointly with one other person	18.7	5.7	30.1	35.4	14.3	14.3	26.7	8.3
Agree that people here look out mainly for the welfare of their own families (%)								
Strongly agree	38.7	20.0	43.7	45.2	11.4	55.7	37.3	37.5
Agree	52.0	52.9	39.4	35.5	60.0	31.4	54.7	62.5
Disagree	5.3	20.0	16.9	16.1	8.6	8.6	4.0	0.0
Strongly disagree	4.0	7.1	0.0	3.2	20.0	4.3	4.0	0.0
Physical assets								
Having land planted with trees (%)	89	97	95	79	76	69	80	94
Owning a house/houses (%)	92	90	99	92	87	100	91	100
Owning a shop/shops (%)	15	6	17	9	16	21	7	6
Owning a tractor (%)	7	0	19	19	17	31	21	6
Owning a car (%)	15	27	14	25	29	21	7	1
Having a pick-up (%)	13	30	52	19	10	0	21	0
Having sheep (%)	1	56	25	14	41	53	29	1
Having cows (%)	7	0	3	6	26	19	23	18
Having goats (%)	13	59	26	29	1	1	23	1
Having bee hives (%)	4	0	1	23	6	10	9	8
Average number of sheep	0	90	34	4	16	24	10	1
Average number of goats	11	37	12	13	7	3	4	1
Average number of cows	0	0	0	0	0	0	1	1
School availability in the village (%)	100	99	99	97	100	100	100	96
Availability of public clinic in the village or around (%)	97	91	88	46	100	93	79	46
Household benefits from public clinic services (%)	99	90	76	42	97	84	75	32
Availability of a telephone in the house (%)	81	83	78	83	59	77	80	68
Availability of electricity in the house (%)	95	96	99	95	96	99	100	100
Having a separate kitchen in the house (%)	96	80	96	92	94	94	97	86
Having a satellite dish and T.V. (%)	67	49	49	34	97	70	97	96
Average number of rooms in the house	5	4	6	5	5	5	5	4

Table 2A: Household size and characteristics

Item		Jordan		Lebanon		Palestine		Syria	
Household size		7		8		11		8	
		In-farm	Out-farm	In-farm	Out-farm	In-farm	Out-farm	In-farm	Out-farm
< 7 years	M					1			
	F					1			
8-15 years	M			1		1			
	F			1		1			3
16-59 years	M	2		2		3			3
	F	2		2		3			
> 60 years	M								
	F								

Table 3A: Farm management in absence of household head (%)

	Jordan	Lebanon	Palestine	Syria
Wife	35	51	33	43
Eldest son	37	31	50	30
Others	28	18	17	27

Table 4A: Income sources (%)

Item	Jordan	Lebanon	Palestine	Syria
Off-farm	65	48	51	44
Farm	35	52	49	56
Crops	6	9	26	9
Fruit trees		34	11	39
Livestock		9	12	8

Table 5A: Income sources (%)

Item	Lebanon		Palestine		Syria	
	Aarsal	Baalbak	Khalil	Jenin	Sweida	Al-Haffeh
Off-farm	59	36	43	59	43	46
Farm	41	64	57	41	57	54
Crops	5	15	33	18	13	5
Fruit trees	31	34	12	10	31	46
Livestock	5	15	12	13	12	3

Table 6A: No. of plots (% of farmers)

No. of plots	Jordan	Lebanon	Palestine	Syria
1	46	99	100	99
2	30	91	99	78
3	18	77	95	65
4	8	51	69	50
5	3	33	58	40
6	1	18	41	25
7	1	12	24	14
>= 8	0	8	9	2

Table 7A: Wild and local trees in Jordan

Type of tree	%of households owning trees	Average no. of trees per household	Standard deviation
Local fig trees	30	16	37
Wild fig trees	23	4	17
Local grape trees	18	279	324
Wild grape trees	27	26	76
Local pear trees	10	292	1027
Wild pear trees	6	131	351
Local almond trees	15	90	197
Wild almond trees	13	68	130
Local botom trees	6	6	12
Wild botom trees	11	22	32
Local apple trees	20	598	2135
Wild apple trees	8	148	270
Local peach trees	12	22	29
Wild peach trees	6	29	54
Local olive trees	32	397	560
Wild olive trees	8	156	338
Local cherry trees	7	134	269
Wild cherry trees	3	17	13
Local apricot trees	9	981	3312
Wild apricot trees	4	38	45
Local plum trees	11	302	779
Wild plum trees	4	7	16
Local pomegranate trees	3	66	54
Wild pomegranate trees	1	0	.
Local forest trees	3	266	435
Wild forest trees	3	167	225

Table 8A: Wild and local trees in Lebanon

Type of tree	% of households owning trees	Average no.of trees per household	Standard deviation
Wild fig trees	0	0	0
Local fig trees	62	21	47
Wild grape trees	47	2	12
Local grape trees	59	94	133
Wild pear trees	59	21	41
Local pear trees	50	13	44
Wild almond trees	52	60	145
Local almond trees	51	14	41
Wild botom trees	49	14	51
Local botom trees	0	0	1
Wild apple trees	0	0	0
Local apple trees	46	5	38
Wild peach trees	0	0	0
Local peach trees	0	0	2

Table 9A: Wild and local trees in Palestine

Type of tree	% of households owning trees	Average no. of trees per household	Standard deviation
Wild fig trees	1	2	.
Local fig trees	39	8	11
Local grape trees	41	156	314
Wild pear trees	2	8	2
Local pear trees	5	15	19
Wild almond trees	6	60	64
Local almond trees	43	58	150
Wild botom trees	21	50	62
Local botom trees	2	2	2
Local apple trees	12	39	51
Local peach trees	7	28	42
Wild other trees -1	18	59	120
Local other trees -1	21	137	166
Wild other trees -2	11	73	111
Local other trees -2	6	41	49

Table 10A: Wild and local trees in Syria

Type of tree	% of households owning trees	Average no. of trees per household	Standard deviation
Wild fig trees	3	4	2
Local fig trees	64	10	13
Wild grape trees	5	86	148
Local grape trees	75	292	543
Wild pear trees	7	8	6
Local pear trees	48	20	26
Wild almond trees	8	9	6
Local almond trees	48	30	51
Wild botom trees	18	14	23
Local botom trees	3	3	4
Wild apple trees	5	23	35
Local apple trees	61	175	322
Wild peach trees	1	10	.
Local peach trees	22	10	12
Wild cratagous trees	15	4	4
Local cratagous trees	3	13	11
Wild cherry trees	1	30	.
Local cherry trees	14	52	54
Local apricot trees	1	27	33
Wild olive trees	1	5	.
Local olive trees	36	143	164
Local plum trees	6	52	63

Table 11A: Land tenure

Item	Jordan			Lebanon			Palestine			Syria		
	Total	Mouqer	Ajloun	Total	Aa	B	Total	K	J	Total	S	L
Area (du)	58	89	29	13	14	11	14	11	16	10	16	4
Land tenure (%)												
Owned	82	77	88	89	99	79	81	97	64	98	100	96
Shared	7	6	8	7	1	12	6	2	10	2	0	4
Rented	10	18	2	4	0	9	14	1	26	0	0	0
State			3									
Production system (%)												
Irrigated	23	33	11	39	35	43	6	10	1	8	8	8
Rainfed	77	67	88	61	65	57	94	90	99	92	92	92

Table 12A: Abandoning local varieties in Lebanon (% of farmers)

Species	Farmers (%)	Reasons for abandoning
Wheat	19	High production costs
Barley	14	Shift to high value crops (fruit trees)
Chickpea	14	Labor unavailability & high labor wage
Lentil	3	
Apricot	0	
Grape	0	
Vicia	2	

Table 13A: Abandoning local varieties in Syria (% of farmers)

Species	Farmers (%)
Wheat	4
Barley	1
Chickpea	1
Lentil	1
Grape	1

Table 14A: Abandoning local varieties in Palestine (% of farmers)

Species	Farmers (%)	Reasons for abandoning
Wheat	10	Availability of new varieties
Barley	1	Crop rotation
Chickpea	2	Changing to irrigation
Lentil	1	Difficult to harvest
Olive	1	

Table 15A: Abandoning local varieties in Jordan (% of farmers)

Species	Farmers (%)
Wheat	6
Barley	0
Chickpea	0
Lentil	0
Apricot	0
Grape	0
Olive	1

Table 16A: Value added as a result of seed treatment ($/d), Normal year (Only Palestine: other countries do not have similar focus on this intervention)

Item	Palestine
Treated	64
Non-treated	59
Net difference (Added value)	5

Table 17A: Change in crop area {Example: Wheat (% of farms)}

Country	Increase (Yes)	Decrease (No)	No change
Jordan (olive)	16	65	19
Lebanon	23	25	52
Palestine	58	3	39
Syria	18	27	55

Table 18A: Change in crop area {Example: Wheat in Lebanon by location}

Area	Increase	Decrease	No change
Aarsal	26	16	58
Balabak	20	38	48
Total	23	25	52

Table 19A: Change in crop area {Example: Wheat in Lebanon by participation }

Participation	Increase	Decrease	No change
Participants	33	13	54
Non-participants	17	31	52
Total	23	25	52

Table 20A: Change in land use (Du) between 2000 and 2004

Crop		Jordan		Lebanon		Palestine		Syria	
		L	I	L	I	L	I	L	I
Wheat	2000	77	40	11	No	11	9	17	25
	2004	78	40	7	No	11	8	10	33
Barley	2000	178	No	9	No	27	No	28	No
	2004	177	No	8	No	7	No	18	No
Lentils	2000	1	No	2	No	2	No	1	No
	2004	2	No	1	No	2	No	1	No
Chickpea	2000	8	No	4	No	2	No	17	No
	2004	4	No	3	No	3	No	24	No

L: Local varieties, I: improved varieties

Table 21A: Market access (% of households)

Market	Jordan	Lebanon	Palestine	Syria
Village market	25	50	35	8
Inside village	12	10	10	20
Neighboring markets	15	3	4	7
City market	43	16	26	34
Combinations	5	21	25	30

Table 22A: Household income (%) by wealth quartiles

Wealth quartiles	Lowest 25%	25-50%	50-75%	Highest 25%	All groups
Jordan					
Selling crop production	34	16	15	8	16
Selling livestock products	3	4	11	29	15
Selling live animals	3	12	14	13	11
Off-farm labor wage from agriculture	2	7	3	2	3
Off-farm labor wage outside agriculture	10	4	5	2	4
Government employee	46	55	50	42	48
Remittance from household members working outside the country	3	1	1	4	3
Other income	0	0	0	0	0
Lebanon					
Selling crop production	49	23	24	21	28
Selling livestock products	3	10	1	11	6
Selling live animals	3	5	3	13	7
Off-farm labor wage from agriculture	3	3	4	2	3
Off-farm labor wage outside agriculture	18	38	51	29	34
Government employee	13	10	13	6	10
Remittance from household members working outside the country	0	1	0	0	0
Other income	13	11	4	17	12
Syria					
Selling crop production	57	41	29	30	34
Selling livestock products	7	4	4	5	5
Selling live animals	2	4	2	4	4
Off-farm labor wage from agriculture	2	2	1	0	1
Off-farm labor wage outside agriculture	10	11	11	3	6
Government employee	20	27	44	10	20
Remittance from household members working outside the country	1	10	8	1	4
Other income	1	0	0	46	26
Palestine					
Selling crop production	28	28	27	25	27
Selling livestock products	4	5	3	8	6
Selling live animals	7	11	3	31	16
Off-farm labor wage from agriculture	4	4	4	2	3
Off-farm labor wage outside agriculture	34	18	34	22	26
Government employee	14	24	19	5	14
Remittance from household members working outside the country	1	0	0	0	0
Other income	8	9	10	7	8

Table 23A: Average household income from agriculture by participation and wealth

Groups	Wealth quartiles	Jordan			Lebanon			Palestine			Syria		
		Average (JD)	N	Gini Index	Average (LL)	N	Gini Index	Average (US$)	N	Gini Index	Average (SL)	N	Gini Index
Agrobiodiversity enhancement	Lowest 25%	1346	8		6790000	12		2765	17		52778	9	
	25-50%	892	6		4750000	11		2765	22		103556	9	
	50-75%	3549	3		5959545	11		3105	19		60333	12	
	Highest 25%	7830	5		9292857	7		6266	25		213228	18	
	Total	2996	22	**0.591**	6447195	41	**0.401**	3897	83	**0.463**	124356	48	**0.477**
Value added income	Lowest 25%	1689	6		4300000	2					29000	5	
	25-50%	483	2		2475000	4					57500	4	
	50-75%	5200	1		1050000	1					10400	5	
	Highest 25%	1300	1		8350000	5					150000	1	
	Total	1760	10	**0.336**	5108333	12	**0.433**				38467	15	**0.430**
Field days/ Training courses	Lowest 25%	2201	10		5000000	1		500	1		35000	4	
	25-50%	3497	7		2511250	2					45000	2	
	50-75%	250	2		10750000	1					50000	3	
	Highest 25%	5345	6		3983333	3		9500	1		107500	2	
	Total	3162	25	**0.436**	4674643	7	**0.371**	5000	2	**0.475**	54091	11	**0.488**
Non-participants	Lowest 25%	1031	13		4005000	19		2125	17		53444	18	
	25-50%	1472	21		3268056	18		5390	12		47696	23	
	50-75%	1679	29		2190095	21		3286	17		48824	17	
	Highest 25%	2504	25		4902500	20		15295	9		133133	15	
	Total	1768	88	**0.438**	3576436	78	**0.391**	5351	55	**0.559**	66932	73	**0.476**
Total	Lowest 25%	1522	37		5034559	34		2390	35		47833	36	
	25-50%	1714	36		3599929	35		3691	34		61816	38	
	50-75%	1858	35		3627853	34		3190	36		47459	37	
	Highest 25%	3652	37		6194286	35		8680	35		172225	36	
	Total	2194	145	**0.469**	4618257	138	**0.399**	4484	140	**0.503**	81817	147	**0.511**

CONSERVATION AND SUSTAINABLE USE OF DRYLAND AGROBIODIVERSITY

Syria-Jordan-Lebanon-Palestinian Authority

GEF/UNDP/ICARDA/IPGRI/ACSAD

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