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Risiko og risikohandtering i økologisk jordbruksproduksjon

Risk and risk management in organic farming

Ola Flaten
Gudbrand Lien
Martha Ebbesvik
Matthias Koesling
Paul Steinar Valle

NILF
Norsk institutt for landbruksøkonomisk forskning

NORSØK
Norsk senter for økologisk landbruk

Norges veterinærhøgskole

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Forfattere	Ola Flaten, Gudbrand Lien, Martha Ebbesvik, Matthias Koesling, Paul Steinar Valle
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- Utarbeider nærings- og foretaksøkonomisk dokumentasjon innen landbruket; dette omfatter bl.a. sekretariatsarbeidet for Budsjettnemnda for jordbruket og de årlige driftsgranskingene i jord- og skogbruk.

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Forord

Mange har studert driftsøkonomiske forhold ved økologisk gardsdrift, men få har inkludert risikohensyn. Dette gjelder nasjonalt så vel som internasjonalt. Forskningsprosjektet «Risiko og risikohandtering i økologisk jordbruk» har hatt som hovedmål å øke kunnskapen om risiko og risikohandtering innenfor økologisk jordbruksproduksjon i Norge. Prosjektet har vært et samarbeid mellom Norsk institutt for landbruksøkonomisk forskning (NILF), Norsk senter for økologisk landbruk (NORSØK) og Norges veterinærhøgskole (NVH) og ble gjennomført i perioden juli 2002 til juni 2005. NILF har hatt prosjektledelsen. Prosjektet ble finansiert av Norges forskningsråd og forskningsmidler over Jordbruksavtalen.

Denne rapporten har to hoveddeler: en samlerapport og en rekke vedlegg. Samlerapporten dekker bakgrunn for prosjektet, kort om opplegg for undersøkelsene, samt en oversikt over og sammendrag av resultat fra de arbeider som er utført. Vedlegga består av internasjonalt publiserte vitenskapelige artikler, foreløpig upubliserte artikler samt utvalgte populærvitenskapelige artikler fra prosjektet. En fullstendig oversikt over vitenskapelige utgivelser og anna publisering i prosjektet er også vedlagt.

NILFs medarbeidere i prosjektet har vært seniorforskerne Ola Flaten og Gudbrand Lien. Lien var prosjektleder i første og Flaten i andre halvdel av prosjektperioden. Fra NORSØK har fagkonsulent Martha Ebbesvik og forsker Matthias Koesling deltatt, mens instituttleder Paul Steinar Valle ved Institutt for produksjonsdyrmedisin har stått for bidraget fra NVH. Disse fem personene har ansvaret for denne rapporten.

Den delen av prosjektet som bruker data fra dyrkingssystemforsøka bygger på et samarbeid mellom NILF og forskerne Audun Korsæth og Ragnar Eltun ved Planteforsk Apelsvoll forskingssenter. I samme del deltok også professor James W. Richardson og daværende stipendiat Keith D. Schumann fra Texas A&M University og professor emeritus J. Brian Hardaker fra University of New England, Australia. Hardaker har også kommentert utkast til flere av artiklene og det engelske sammendraget. Som det går fram av de enkelte artikler, er det også samarbeidet med direktør Anne Moxnes Jervell ved Statens institutt for forbruksforskning, høgskolelektor Halvard Arntzen ved Høgskolen i Molde og professor Joseph F. Hair Jr. fra Louisiana State University i deler av prosjektet. Førstesekretær Berit Helen Grimsrud og konsulent Siri Fauske har klargjort rapporten for trykking.

Prosjektgruppa vil rette en stor takk til alle gardbrukerne som flittig og ordentlig fylte ut det omfattende spørreskjemaet de ble tilsendt.

Oslo, desember 2005

Ivar Pettersen

Innhold

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Sammendrag

Ofte får gardbrukere erfare at produksjon og inntekt ikke blir som en hadde tenkt seg på forhånd. En gardbruker har aldri full kontroll over de tallrike faktorene som påvirker drifta, og usikre framtidige konsekvenser innebærer risiko. Mange tenker mest på de ugunstige situasjonene en kan bli utsatt for, og som blant anna skyldes avlingssvikt, naturkatastrofer, prisfall og uheldige politikkendringer. I verste fall kan slike forhold rasere inntekter og formuesverdier til gardbrukere.

Få driftsøkonomiske studier innen økologisk jordbruk har tatt hensyn til risiko. Dette gjelder nasjonalt så vel som internasjonalt. Hovedmålet med prosjektet har vært å øke kunnskapen om risiko og risikohandtering innenfor økologisk jordbruksproduksjon i Norge.

Med utgangspunkt i hovedmålet ble følgende delmål opprinnelig formulert for prosjektet:

1. Belyse omfang av risiko, spesielt avlings-, avdråtts-, dyrehelse-, pris- og inntektsrisiko knyttet til økologisk gardsdrift.
2. Belyse hvilke strategier økologiske produsenter nytter for å handtere risiko.
3. Utvikle gardsmodeller for å analysere økonomisk optimal tilpassing ved usikkerhet i økologisk jordbruk.

I tillegg til å belyse disse delmåla, har prosjektet også gitt informasjon om forskjeller i driftspraksis og holdninger hos tidlige og nye økologiske brukere, potensialet for omlegging til økologisk drift samt drift og risikooppfatninger hos heltids- og deltidsbrukere.

I denne rapporten er det gitt en oversikt over datakilder og metoder som er nyttet i prosjektet og viktige resultat som er oppnådd. Flere detaljer fra undersøkelsene finnes i de vitenskapelige utgivelsene fra prosjektet. En rekke av disse artiklene er vedlagt rapporten.

Første halvår 2003 ble det gjennomført en landsomfattende spørreundersøkelse blant gardbrukere om risiko i jordbruket. Utvalget ble avgrenset til mjølke- og planteprodusenter. Spørreundersøkelsen ble sendt representative utvalg av konvensjonelle brukergrupper samt alle kontrollerte og godkjente økologiske produsenter innen de to driftsgreinene. Nesten 1 700 spørreskjema ble sendt ut, og mer enn 1 000 kom tilbake i utfylt stand. Opplysninger fra spørreundersøkelsen ble koplet med data fra produksjonstilskottsregisteret, Husdyrkontrollen og helsekortordninga. Dataene ble undersøkt på mange forskjellige måter, inkludert flere studier som sammenliknet grupper av økologiske og konvensjonelle brukere.

Spørreundersøkelsen viste at det viktigste målet for økologiske brukere var å drive miljøvennlig og bærekraftig (å ta vare på kulturlandskapet inkludert). På andreplass kom produksjon av kvalitetsmat. Viktigst for de konvensjonelle brukerne var å ha en sikker og stabil inntekt, foran det å produsere kvalitetsmat. Størst mulig inntekt ble rangert lågt, og lågest hos de økologiske brukerne.

Flere økologiske enn konvensjonelle brukere uttrykte vilje til å ta risiko.

Både økologiske og konvensjonelle brukere oppfattet politikk som alvorligste kilde til risiko. Politisk risiko handlet om mer enn usikre priser og tilskott. Skatte- og avgiftspolitikk, mjølkekvoteregelverk, dyrevelferdskrav, miljøkrav, osv. ble også rangert høgt. Økologiske brukere var svært opptatt av risikokilder tilknyttet rammevilkår for økologisk drift (økologiske tilskott, merpris og regelverk for økologisk drift). Flere konvensjonelle enn økologiske brukere var engstelige for usikkerhet om priser på innkjøpte drifts- og anleggsmidler og dyrevelferdskrav. For å moderere gardbrukernes frykt for politisk risiko synes det viktig at vilkår for næringsdrift er langsiktige, stabile og forutsigbare.

God likviditet ble sett på som viktigste tiltak for å handtere risiko. Å forebygge sjukdommer og skadedyr hos dyr og planter kom på andreplass. Andre viktige tiltak var kjøp av landbruksforsikring samt å produsere til låg kostnad. Økologiske og konvensjonelle brukere hadde ganske like syn på strategier for å styre risiko. De gardbrukerne som var mest bekymret for politisk risiko var mest opptatt av økonomiske tiltak som å ha god likviditet, lite gjeld og å produsere til låg kostnad.

Færre økologiske enn konvensjonelle kyr ble registrert med sjukdomsbehandlinger. Spørreundersøkelsen viste at økologiske husdyrbrukere gjorde mer bruk av alternativ behandling og oftere utførte egenbehandling enn de konvensjonelle. Ved å korrigere for forskjeller i egen helsehandtering, ble antall «faktiske» sjukdomstilfeller til økologiske mjølkekyr om lag som i konvensjonelle buskaper. Mastitt forekom sjeldnere ved økologisk drift, men dette ble forklart av en lågere mjølkeavdrått i økologiske besetninger. Det var derfor ingen klare tegn på at økologisk drift utover et lågere avdråttsnivå, ga helsegevinster.

Forskjeller mellom økologiske mjølkeprodusenter gruppert etter omleggingstidspunkt ble undersøkt. De nye økologiske mjølkeprodusentene (omlagt i 2000 eller senere) hadde et mer pragmatisk syn på økologisk drift og filosofi enn de som var tidlig ute (omlagt i 1995 eller tidligere). De tidlige hadde gjerne ei allsidig gardsdrift, mens mange nykommere drev mer spesialisert og intensivt. De som var tidlig ute med å legge om la stor vekt på miljøhensyn samt økologisk ideologi og filosofi som motiv for økologisk drift. Hos nykommerne var bedre lønnsomhet og ekstra tilskott til økologisk drift ei mye viktigere drivkraft for å legge om, men også hos disse var flertallet mest opptatt av miljøhensyn, bærekraft og kvalitetsmat.

Bare 4 % av de konvensjonelle brukerne ga i spørreundersøkelsen uttrykk for at de hadde planer om å legge om hele eller deler av garden til økologisk drift innen 2009. Nesten 75 % utelukket å legge om, mens 18 % uttrykte at de var usikre. Bare 2 % av de økologiske bøndene uttrykte et ønske om gå tilbake til konvensjonell drift. For å nå landbrukspolitiske mål om 10 % økologisk jordbruksareal innen 2009 og 15 % av matproduksjonen som økologisk i 2015, må de som uttrykte at de vil legge om og mange av de usikre virkelig legge om.

Gardbrukerne rapporterte at de viktigste grunnene til å arbeide utenfor bruket var å øke og stabilisere husholdsinntekten. Sammenlikninga av deltids- og heltidsbrukere viste forskjellige mål med gardsdrifta, risikooppfatninger og strategier for risikostyring. Arbeid utenfor bruket var viktigste risikostrategi for planteprodusenter på deltid. Flere deltidsbrukere enn heltidsbrukere hadde planer om å produsere mindre på garden.

En optimeringsmodell av typen diskret stokastisk programmering ble utviklet for å undersøke optimal tilpassing under usikkerhet på økologiske mjølkebruk. Modellen er en årsplan med start om våren, og den tar hensyn til avlings- og prisrisiko. Paneldata fra økologiske mjølkebruk i driftsgranskingene til NILF kombinert med subjektive ekspertanslag ble benyttet for å berekne historisk samvariasjon i de usikre variablene. Modellen maksimerer forventa nytte ved ulike holdninger til risiko hos gardbrukeren.

Optimeringsmodellen ble brukt for å undersøke hva som skjer når alt fôr må være økologisk, og at det fra august 2005 ikke lenger kunne nyttes inntil 15 % av fôret som billigere ikke-økologisk fôr. To brukstyper under flatbygdvilkår ble undersøkt. Begge brukstypene hadde en mjølkekvote på 100 000 liter, men arealgrunnlaget var forskjellig. Den ene brukstypen erstattet alt konvensjonelt kraftfôr med økologisk, den andre produserte mindre mjølk. Begge brukstypene fikk et inntektstap på nærmere 20 000 kr i året på grunn av det nye fôrkravet.

En stokastisk simuleringsmodell ble spesifisert for å sammenlikne risiko ved økologiske, integrerte og konvensjonelle driftssystem i planteproduksjonen. Avlingsdata (1991–1999) fra systemforsøka med åkervekstene korn og potet ved Planteforsk Apelsvoll forskingssenter ble benyttet. Det ble supplert med priser og arbeidstall fra andre datakilder. Simuleringsmodellen tar hensyn til usikkerhet i avling og pris for vekster og til samvariasjon mellom usikre variable innen et dyrkingssystem. I modellen blir det bereknet sannsynlighetsfordelinger for gardbrukers inntekt.

Avlingene i det økologiske driftssystemet var 60–65 % av det konvensjonelle. Men økologiske avlinger og inntekter varierte mer mellom år. Med nåværende tilskottsordninger og økologiske pristillegg svarte det seg likevel best økonomisk med økologisk dyrking, også for gardbrukere med sterk motvilje mot å ta risiko. Sjøl om tilskott til økologisk drift falt bort, kunne økologisk drift fortsatt være fordelaktig. Dersom pristillegga også forsvant, ble økologisk drift klart minst gunstig i optimeringsmodellen. Integrert og konvensjonell dyrking kom omtrent likt ut økonomisk.

Avslutningsvis blir det i rapporten pekt på flere områder og vinklinger for videre forsking. Det aller mest interessante og utfordrende området synes å være politisk (institusjonell) risiko. Gardbrukerne oppfattet politiske forhold som viktigste risikokilde, men det er forsket lite på politisk risiko i jordbruket i Norge så vel som andre land.

Summary

Farmers often find that farm production and financial performance do not turn out as expected in advance. A farmer does never have complete control of all the factors affecting outcome, and uncertain consequences imply risk. Usually farm people are most worried about the bad outcomes they may be exposed to, caused by crop failures, natural disasters, price declines, or adverse policy changes. All these can negatively affect farmers' incomes and net assets.

Studies of risk and risk management in organic farming have been few. The principal aim of this project has been to increase knowledge about risk and risk management in organic farming in Norway. The main aim was to be pursued through the following sub-goals:

1. Assess organic farmers' exposure to risk, especially risks related to crop yields, livestock performance, animal health, prices and income.
2. Identify organic farmers' risk management strategies.
3. Develop farm models to examine optimal adjustments under risk in organic farming.

In addition to examining these issues, the project has also involved studies comparing farm management practices and attitudes of late and early converters to organic farming, the potential for conversion to organic farming in Norway, and management and risk characteristics of part-time and full-time farmers.

This report deals with an overview of materials and methods used in the project and the most important results achieved. More details are to be found in the papers produced in the project. Several of these papers are enclosed as Appendices to this report.

A nation-wide questionnaire survey of risk and risk management in farming was conducted between January and April 2003. Samples were selected from Norwegian crop and dairy farmers. Conventional farmers were selected using random sampling, while all organic dairy and crop farmers received the questionnaire. Approximately 1700 questionnaires were sent out. More than 1000 farmers returned the questionnaire. Data obtained from the completed questionnaires were merged with data from the Norwegian Agricultural Authority, the Norwegian Herd Recording System and the Norwegian Cattle Health Services. The data were analysed in various ways, including several studies which compared information about groups of organic and conventional farmers.

The questionnaire showed that organic farmers ranked sustainable and environmentally sound farming (landscape preservation included) as the most important goal and producing high quality food second. Conventional farmers ranked reliable and stable income first and food quality second. All groups of respondents assigned a rather low rank to profit maximization, with lowest rank assigned by organic farmers.

Organic farmers on average felt that they were more willing to take risk than did conventional farmers.

Institutional risks were perceived as primary sources of risk, with uncertainty about farm support payments and output prices ranked most highly. Other institutional risks, such as tax policy, milk quota policy and animal welfare policy, also had high scores. Organic farmers gave high scores to factors related to their production system, i.e., organic farming payments, price premiums, and organic regulations. Compared to their organic colleagues, conventional farmers were more concerned about costs of purchased inputs and animal welfare policy. It is clear that a stable and predictable agricultural policy is important to mitigate farmers' worries about institutional risks.

Having good liquidity was perceived by these farmers as the most important way to handle risk. Disease prevention was rated second. Other important strategies were buying farm business insurance and producing at lowest possible cost. Organic and conventional farmers' management responses were relative similar. Institutional sources of risk were highly related to financial management responses (solvency, liquidity, and low-cost production).

Organic dairy herds showed a lower level of registered disease treatments per cow, mainly related to fewer veterinary visits and medical treatments, than conventional herds. The questionnaire showed differences in handling animal health problems between the two groups, i.e., a higher degree of self-induced non-medical disease handling as well as more of alternative medicine treatments in organic herds. After adjusting for the differences in health handling, only a lower level of acute mastitis in organic herds remained. When controlling for production level, milk yield being lower in organic herds, this difference also disappeared. Therefore, given the same level of production, few if any gains in health performance of organic compared to conventional dairy systems could be found.

Differences between organic dairy farmers categorised by their year of conversion to organic farming were examined. The new, late-entry organic dairy farmers (converted in 2000 or later) had a more pragmatic view of organic farming practices and philosophical ideals than the early entrants (converted in 1995 or earlier). The early entrants tended to undertake more mixed farming. Later converting farmers were more specialised, and the intensity of their milk production was generally higher than the early entrants. Soil fertility/pollution issues and philosophical concerns strongly motivated the early entrants. Financial reasons (organic farming payments included) were important for a considerable number of the newcomers' decision to go organic. However, also among the late entrants, environmental, food quality, and philosophical concerns were more widely present as motives for conversion than the financial ones.

Only 4% of the conventional farmers reported plans to convert the whole or part of the farm to organic farming practices by 2009. Almost 75% of them were not interested in a conversion, while 18% were uncertain whether they would convert or not. Only 2% of the organic farmers planned to revert to conventional farming. To achieve the Ministry of Agriculture's goals of 10% organically managed area by 2009 and 15% of the food production as organic in 2015, it will be necessary for all farmers with conversion plans and most of the uncertain ones to actually convert.

The most important reasons for working off-farm work, independently of crop or dairy farming, were to increase and stabilize the farm household income. The comparison of part-time and full-time farmers indicated that their goals, risk perceptions and management responses differed significantly. For part-time crop farmers off-farm work was the most important risk management strategy. More part-time farmers than full-time farmers planned to downsize their farm operation.

A two-stage discrete stochastic programming model of organic dairy farms that accounted for embedded as well as non-embedded risk was developed. The model assumes a one-year plan starting in spring. Livestock revenues and crop yields were specified as stochastic variables. Historical data from organic dairy farms in NILF's Farm Accountancy Survey and subjective judgements were combined to assess the nature of the uncertainty. The expected utility model was used as a normative model of farmers' behaviour under risk.

The stochastic programming model was used to assess adjustments in resource use and financial impacts on organic dairy herds due to the requirement of 100% organic feed in organic livestock systems from August 2005. Earlier, the maximum percentage of conventional feedstuffs authorized per year was 15%. Two types of model farms reflecting conditions in the lowlands of Southern Norway were analysed. The annual milk quota on both farms were set at 100 000 litres, while their farmland resources varied. In one of the farm types, the only adjustment was to directly substitute purchased conventional concentrates with more expensive organic concentrates. The other farm type produced less milk. In both cases, the 100% organic feed regulation caused economic losses of almost NOK 20 000 (or 6–8% of the expected net income) compared to the earlier regulation.

A stochastic simulation model was specified to compare risk in organic, integrated and conventional cropping systems. Experimental cropping systems data (1991–1999) for rotations of grains and potatoes from Apelsvoll Research Station in Eastern Norway were used, supplemented with prices and labour requirements from other data sources. The model takes into account variability in yields and prices for individual crops in the three cropping systems as well as the stochastic dependency between the random variables. A smoothing procedure was developed and applied to adjust for irregularities in the sparse sample data. The simulation model yielded estimated empirical probability distributions for annual net farm income.

Average crop yields in the organic system at Apelsvoll were 60–65% of those under conventional management. The relative variability in yields, judged by coefficients of variation, was generally highest in the organic system. With current organic price premiums and area payments for organic farming included, the results showed that the organic cropping system stands out as the most economically viable and preferred alternative, even for highly risk-averse farmers. Even if organic area payments were to be removed, the organic system would be the most preferred for low to moderately risk-averse farmers. If also the organic price premiums eroded, the other two cropping systems would be preferred by all farmers, regardless of degree of risk aversion. The distributions of returns for conventional and integrated cropping were quite equal.

Finally a number of future research areas and directions were identified. The most interesting and challenging field seems to be studies of institutional (policy) risk. Farmers perceived policy factors as a major source of risk, yet the attention given to institutional risk has been limited in Norway as well in other countries.

1 Innledning

1.1 Bakgrunn

De første økologiske (organiske) jordbruksfilosofene tidlig på 1900-tallet ønsket å utvikle et driftssystem som så langt som råd nyttet brukets egne ressurser, og som bare tydde til eksterne ressurser når det var strengt nødvendig og hensiktsmessig (Dabbert *et al.*, 2004). I nåværende norske regelverk for økologisk jordbruksproduksjon påpekes at økologisk jordbruk tilstreber et sjølbærende og vedvarende agro-økosystem i god balanse (Mattilsynet, 2005). Systemet baseres mest mulig på lokale og fornybare ressurser. Økologisk produksjon bygger på et helhetssyn som omfatter de økologiske, økonomiske og sosiale sidene ved jordbruksproduksjonen, både i lokalt og globalt perspektiv. I det økologiske jordbruket betraktes naturen som en helhet. Driftsformen tilstreber et allsidig driftsopplegg med bruk av naturlige og fornybare ressurser som husdyrgjødsel og belgvekster. Det settes klare grenser for gjødselmengder og fôrimport til bruket. Bruk av plantevernmidler er strengt regulert, og svært få stoffer er tillatt brukt.

Økologiske driftsformer er prøvd ut i Norge siden først på 1930-tallet. Fram til 1970-tallet var driftsformen lite utbredt. De siste femten åra er det arbeidet aktivt for å øke den økologiske jordbruksproduksjonen i Norge. Siden 1990 er det gitt særskilt arealtilskott til gardbrukere som legger om til og driver økologisk jordbruk. I 1995 ble det innført ei ordning med gratis mjølkekvote til økologiske gardsbruk som ikke hadde kvote fra før av. Tilskott til økologisk husdyrhold ble innført i 2001. Fra 1996 har foredlingsindustrien gitt økologiske pristillegg for flere produkter, mjølk og kjøtt inkludert.

Antall godkjente økologiske driftsenheter i Norge har økt fra 423 i 1991 til 2484 i 2004 (Debio, 2005). I samme periode har det økologiske jordbruksarealet (jordbruksareal under omlegging ikke inkludert) steget fra 18 145 daa til 349 567 daa. I 2004 utgjorde økologiske jordbruksareal til sammen 3,3 % av det totale jordbruksarealet i drift. Det økologiske husdyrholdet har også vokst. For eksempel økte meierileveransen av økologisk mjølk fra 3,6 mill. liter i 1997 til 24,3 mill. liter i 2004 (Statens landbruksforvaltning, 2005). I 2004 var 1,6 % av all mjølkeproduksjon økologisk, men bare 25 % av mjølka nådde forbrukerne som økologisk merket vare.

Forbrukerundersøkelser i flere land har vist interesse for og ekstra betalingsvilje for økologisk mat (f.eks. Huang, 1996; Torjusen *et al.*, 2001). Avvik mellom holdinger og faktisk kjøpsatferd er påvist, hvor de som er positive til økologisk mat ikke alltid kjøper den (Shepherd *et al.*, 2005). I mange år vokste forbruket av økologisk mat raskt, men veksten har stagnert i enkelte land (Smith og Marsden, 2004; Yuseffi, 2005).

Ut fra utviklinga i det norske markedet og forbruksutviklinga i naboland, la myndighetene opp til ett mål om at 10 % av jordbruksarealet skulle være omlagt til økologisk areal i løpet av 2009 (Landbruksdepartementet, 1999), forutsatt at det finnes et marked for avsetning av produkta. Satsinga hadde sin bakgrunn i driftsformens muligheter til å bidra til å nå landbrukspolitiske mål og føre jordbruket i mer bærekraftig retning (Landbruksdepartementet, 1999). Den nye regjeringas mål er at 15 % av matproduksjonen og matforbruket i 2015 skal være økologisk (Statsministerens kontor, 2005). Mange gardbrukere må finne det interessant å legge om til og opprettholde økologisk drift, for at økologiske produksjonsmål skal kunne nås.

Gardbrukeres motiv for å drive økologisk er mange og varierte. Studier fra andre land har vist at pionerene var sterkt opptatt av problema ved intensiv jordbruksdrift og ideologiske og filosofiske forhold. For de som har lagt om i det senere har hensynet til miljø og egen inntjening vært viktigere (Padel, 2001). I Finland har en funnet at økte økologiske tilskott oppmuntret flere til å legge om til økologisk drift (Pietola og Lansink, 2001). Økonomiske hensyn synes derfor viktig for å kunne øke den økologiske jordbruksproduksjonen.

Internasjonalt har mange studert driftsøkonomiske forhold ved økologisk jordbruk (se f.eks. Lampkin og Padel, 1994; Lansink *et al.*, 2002; Häring, 2003; Acs *et al.*, 2005). Offermann og Nieberg (2000) har gitt en oversikt over inntjening i økologisk jordbruk i europeiske land, samt hvilke forhold som påvirker lønnsomheten ved overgang fra konvensjonell til økologisk drift. Økologiske avlinger var lågere enn de konvensjonelle, men pristillegg i markedet og ekstra tilskott gjorde økologisk drift til et økonomisk interessant alternativ i mange land.

I Norge har Vittersø (1995, 1997) vurdert lønnsomheten i økologisk mjølkeproduksjon. Resultata viste lågere variable kostnader, men høgere totale kostnader per kg mjølk i økologisk enn i konvensjonell drift. Dersom det kunne tas ut en merpris for økologisk mjølk og det ble gitt særskilte tilskott, kunne likevel lønnsomheten bli minst like god som ved konvensjonell drift, men avhengig av avlingsnedgang, prosent innkjøpt fôr og merarbeid.

Repstad og Eltun (1997) og Eltun *et al.* (2002) nyttet data fra systemforsøka ved Planteforsk Apelsvoll forskingssenter til driftsøkonomiske analyser. Berekningene viste bedre lønnsevne (per time) i det økologiske åkervekstsystemet med korn og poteter enn ved konvensjonell eller integrert dyrking. Dersom priser og tilskudd var likt med konvensjonell drift, falt økonomien i økologisk drift drastisk. I fôrvekst-systema var økologisk og konvensjonell drift omtrent like lønnsomt (merpris og økologiske tilskott inkludert).

De refererte driftsøkonomiske studiene har i første rekke vurdert lønnsomhet. Sammenlikninger som ser bort fra risiko[1] og bare vurderer forventa lønnsomhet er ikke tilstrekkelig, siden stabilitet i produksjon og inntjening også kan være viktig. Gardbrukere merker ofte at produksjon og inntekt ikke blir som en hadde tenkt seg på forhånd. Jordbruket er sterkt påvirket av biologiske prosesser og er sårbar for værforhold, naturkatastrofer og skadedyr- og sjukdomsangrep. En del tiltak på garden kan gjøres av bruker for å redusere risiko, og forsikringsordninger finnes på enkelte områder. Men uansett vil en gardbruker aldri ha full kontroll over de tallrike faktorene som påvirker drifta, og usikre framtidige konsekvenser innebærer risiko. Mange tenker mest på de ugunstige situasjonene en kan bli utsatt for, og som kan skyldes avlingssvikt, prisfall, uheldige politikkendringer osv. I verste fall kan slike forhold rasere inntekter og formuesverdier til gardbrukere.

1.2 Tidligere studier av risiko i økologisk jordbruk

Det er publisert et stort antall internasjonale arbeid om risiko i jordbruket, se f.eks. Just og Pope (2002), Just (2003) og Hardaker *et al.* (2004a) for en oversikt. Tidligere studier av risiko og risikohandtering ved økologisk jordbruk har vært, så vidt vi kjenner til, fraværende i Norge. Ved oppstarten av prosjektet ble det heller ikke funnet mange studier i andre land, men noen få studier er kommet til etter den tid.

Økologisk jordbruk, som skiller seg fra konvensjonell drift ved sin større avhengighet av naturprosesser i økosystem, kan gjøre økologiske brukere mer utsatt for visse typer risiko og det kan stilles andre krav til å handtere risiko. For eksempel kan restriksjoner på bruk av kjemiske plantevernmidler, lettløselig mineralgjødsel, legemidler av syntetisk opprinnelse, innkjøp av fôr og dyr m.m. gi et annet omfang av produksjonsrisiko. Avgrensingene utelukker en del vanlig brukte strategier for å styre risiko i konvensjonelt jordbruk. Økologiske brukere blir i stedet mer avhengig av å forstå og arbeide i lag med naturen gjennom tiltak som f.eks. vekstskifter, mekanisk ugrasbekjemping, biologisk plantevern og dyrehelsehandtering. Dessuten kommer mer av inntektene fra tilskott ved økologisk drift. Dette bidrar til å stabilisere inntektene, men samtidig er prisutviklinga for økologiske varer usikker. Politisk risiko (lovregler, tilskott m.v.) i økologisk drift kan også avvike fra det konvensjonelle.

Flere studier i Nord-Amerika har sammenliknet inntektsrisiko i økologiske og konvensjonelle driftssystem ved plantedyrking (Mahoney *et al.*, 2004; Smith *et al.*, 2004; Pimentel *et al.*, 2005). Data ble hentet fra langvarige systemforsøk ved

[1] Hardaker *et al.* (2004a: 5) definerer *usikkerhet* som ufullstendig kunnskap og *risiko* som usikre konsekvenser, særlig ugunstige utfall. Å ta risiko betyr derfor at en utsetter seg for muligheter for tap.

forsøksstasjoner og studert med stokastisk dominansanalyse. Undersøkelsene viste bedre forventet inntjening i økologisk enn i konvensjonell drift ved gjeldende pristillegg. Smith *et al.* fant størst inntektsvariasjon i de økologiske driftssystema, Mahoney *et al.* kunne ikke påvise noen risikoforskjeller, mens Pimentel *et al.* rapporterte størst inntektsvariasjon i det konvensjonelle systemet. Uten økologiske pristillegg ble det oppgitt samme (Mahoney *et al.*) eller lågere (Smith *et al.* og Pimentel *et al.*) lønnsomhet i økologisk enn i konvensjonell drift.

Hirschi (2000) undersøkte hvorvidt en kan tjene på å dyrke både økologiske og konvensjonelle vekster på et bruk, ved å utnytte at avlingene i de to driftssystema neppe svinger helt i takt. En optimeringsmodell som maksimerer nåverdi av sikkerhetsekvivalenter[2] ble utviklet. Konvensjonelle og økologiske vekstskifter i Midtvesten av USA ble undersøkt ved forskjellige risikoholdninger til gardbruker. Variasjonen i lønnsomhet var størst ved økologisk dyrking, men økologisk dyrking inngikk til dels i driftsopplegget for brukere med låg risikoaversjon. Med stigende risikoaversjon ble innslaget av økologisk dyrking mindre.

Waibel *et al.* (2001) vurderte rentabilitet ved konvensjonell og økologisk epledyrking i Tyskland. Tradisjonell investeringsanalyse under sikkerhet viste best lønnsomhet ved økologisk dyrking. Konklusjonen var uendret, dersom en tok hensyn til risiko ved hjelp av stokastisk simulering. Ved økologisk dyrking var valg av rett sort viktig for å kontrollere plantesjukdommer samt å oppnå høge eplepriser. Videre var det gunstig å spre risiko ved å dyrke flere sorter i stedet for få.

I USA er det arrangert gruppeintervjuer med økologiske produsenter for å undersøke hvordan de vurderte ulike risikokilder og styringsstrategier (Hanson *et al.*, 2004). Forurensing av økologisk produksjon fra genmodifiserte vekster ved konvensjonell dyrking i nabolaget (også utenfor eventuelle buffersoner) ble sett på som en særlig alvorlig risikokilde. Innblanding kunne føre til tap av så vel salgsinntekter som økologisk godkjenning. Mange fryktet at rask vekst i det økologiske jordbruket skulle føre til fallende økologiske pristillegg i markedet, samt at nisjemarkeder raskt kunne forsvinne. God agronomi, dyrking av flere vekster og salg gjennom flere markedskanaler ble nevnt som viktige strategier for å handtere risiko.

De få studiene i den internasjonale litteraturen viste et tydelig behov for mer risikoforskning innenfor økologisk jordbruksproduksjon. Særlig gjaldt dette innen husdyrholdet og ved brukssituasjoner med kombinert plante- og husdyrproduksjon, hvor det ikke ble funnet noen studier før dette prosjektet ble satt i gang.

1.3 Mal i prosjektet

Hovedmålet i det treårige prosjektet har vært å øke kunnskapen om risiko og risikohandtering innenfor økologisk jordbruksproduksjon i Norge.

Med utgangspunkt i hovedmålet ble følgende delmål skissert i prosjektbeskrivelsen:

[2] En sikkerhetsekvivalent svarer til et sikkert beløp med same nytte som forventet nytte til det usikre alternativet (Hardaker *et al.*, 2004a).

1. Belyse omfang av risiko, spesielt avlings-, avdråtts-, dyrehelse-, pris- og inntektsrisiko knyttet til økologisk gardsdrift.
2. Belyse hvilke strategier økologiske produsenter nytter for å handtere risiko.
3. Utvikle gardsmodeller for å analysere økonomisk optimal tilpassing ved usikkerhet i økologisk jordbruk.

Prosjektet har belyst disse delmåla. I tillegg har prosjektet gitt informasjon om viktige forhold som ikke ble nevnt i de opprinnelige delmåla. Dette gjelder forskjeller i driftspraksis og holdninger hos tidlige og nye økologiske brukere, potensialet for omlegging til økologisk drift samt drift og risikooppfatninger hos heltids- og deltidsbrukere.

1.4 Oppbygging av rapporten

Denne rapporten består av to deler: en samlerapport og en rekke vedlegg. Etter dette innledningskapitlet har samlerapporten tre hovedkapitler. De tre hovedkapitlene skal gi ei innføring i opplegg for undersøkelsene samt en oversikt over og sammendrag av resultat fra de arbeid som er utført i prosjektet. Kapittel 2 beskriver datakilder og metoder som er nyttet i prosjektet. I kapittel 3 presenteres og drøftes viktige resultat fra prosjektet. Til slutt, i kapittel 4, konkluderer og oppsummerer vi resultat og kommer med forslag til videre forskning. Kapitlene 2–4 er skrevet på grunnlag av de vitenskapelige utgivelsene i prosjektet. Ved slutten av underkapitlene henvises det til videre lesing om emnet i vitenskapelige utgivelser og eventuell anna publisering i prosjektet.

Vedlegga beskriver mer detaljert materiale, metoder, resultat og diskusjoner i de enkelte deler av prosjektet. Vedlegga består av internasjonale vitenskapsartikler fra prosjektet, noen foreløpig upubliserte artikler og utvalgte populærartikler. En fullstendig oversikt over vitenskapelige utgivelser og anna publisering i prosjektet samt spørreundersøkelsen er også vedlagt.

2 Opplegg for undersøkelsene

2.1 Innledning

For å belyse delmåla i prosjektet krevdes ulike typer data og en rekke forskjellige analysemetoder. I dette kapitlet skal vi kort presenterte opplegg for undersøkelsene.

I Norge visste en lite om hva gardbrukere anså som de viktigste kilder til risiko og hva de gjør for å «leve med risiko». Kunnskap om disse forholda er imidlertid viktig, fordi de valg gardbrukere gjør avhenger av hvilke risikooppfatninger de har, uavhengig av eventuelle «ekspertråd». I prosjektet ble det lagt stor vekt på å undersøke risikooppfatninger ved hjelp av en spørreundersøkelse. Først beskrives data og utvalg av bruk i spørreundersøkelsen, samt kort om hvordan dette materialet ble analysert.

Deretter beskrives en programmeringsmodell for å analysere optimal tilpassing under usikkerhet ved økologisk mjølkedrift. Til slutt omtales en simuleringsmodell for å sammenlikne risiko i driftssystem ved plantedyrking.

2.2 Spørreundersøkelse om risiko i jordbruket

2.2.1 Data og type spørsmal

Første halvår 2003 ble det gjennomført en spørreundersøkelse om risiko i jordbruket. Gardbrukerne ble stilt spørsmål om hva de oppfattet som de viktigste kilder til risiko, hva de gjorde for å «leve med risiko» og hvilken risikovilje de hadde. Videre ble det spurt om emner som målsettinger med gardsdrifta, motiv for å drive økologisk eller konvensjonelt, planer for gardsdrifta, oppfatninger av miljøkvaliteter ved økologisk i forhold til konvensjonell drift, helsehandtering i mjølkeproduksjonen, arbeidsforbruk, sosioøkonomiske forhold m.v. De fleste spørsmåla var lukket. Spørreskjemaet med følgebrev finnes i vedlegg 14.

Data fra produksjonstilskottsregisteret til Statens landbruksforvaltning og Husdyrkontrollen inkludert helsekortordninga ble koblet med spørreundersøkelsen.

2.2.2 Utvalget

Utvalget i spørreundersøkelsen ble avgrenset til mjølkebønder og plantedyrkere. Mjølkeprodusentene måtte ha minst fem mjølkekyr. Plantedyrkerne skulle ha minst 10 daa korn, eller minst 5 daa potet eller minst 2 daa med grønnsaker, frukt eller bær samt være uten mjølkekyr.

Spørreundersøkelsen ble sendt til et representativt utvalg av konvensjonelle mjølkeprodusenter (n=616) og planteprodusenter (n=611). Alle kontrollerte og godkjente økologiske mjølkeprodusenter (n=245) og planteprodusenter (n=212) fikk tilsendt spørreskjemaet. Det ble gjennomført to purrerunder, først med et påminningskort, deretter ved å sende hele spørreundersøkelsen på nytt. Nesten 1 700 spørreskjema ble sendt ut per post, og mer enn 1 000 utfylte skjema kom tilbake.

2.2.3 Statistiske analyser

I prosjektet ble det nyttet flere statistiske tilnærminger for å analysere det rikholdige datasettet. Variablene ble først analysert ved hjelp av enkel, beskrivende statistikk som gjennomsnitt og standardavvik for metriske variable og tabelloppsummeringer for kategoriske variable.

Noen analyser og arbeid har beskrevet og sammenliknet ulike grupper av respondenter ved hjelp av uni- og bivariate analyser. En svakhet med denne typen statistiske analyser er at de ikke klarer å fange opp komplekse sammenhenger mellom et stort antall variable (Hair *et al.*, 1998; Spicer, 2005). Bruk av multivariate teknikker kan redusere denne begrensinga, og i flere av arbeida ble det gjort.

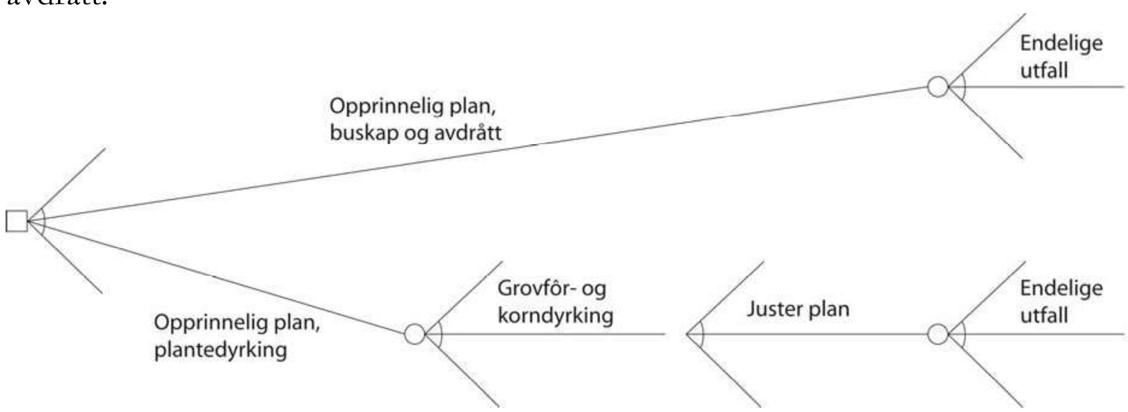
Noen multivariate analyser (faktoranalyser) ble utført for å summere informasjonen i et stort antall variable i færre faktorer. Multiple (minste kvadraters metode og logistiske) regresjonsanalyser ble utført for å undersøke sammenhenger mellom responsvariable og aktuelle forklaringsvariable.

Hvilke tilnærminger som er nyttet, er beskrevet i de enkelte arbeid. I noen av artiklene er også et teoretisk eller konseptuelt rammeverk for undersøkelsen utarbeidet og beskrevet.

2.3 Programmeringsmodell

En matematisk programmeringsmodell ble utviklet for å analysere optimal tilpassing under usikkerhet på økologiske mjølkebruk. Analysemodellen er av typen diskret stokastisk programmering (Cocks, 1968), den optimerer produksjonskombinasjoner (porteføljevalg), tillater produksjons- og prisrisiko, muliggjør at beslutninger tas to ganger underveis i produksjonsprosessen (to steg, se Figur 2.1) og tar hensyn til gardens ressursbegrensinger. Videre ble det tatt hensyn til karakteristiske biologiske og institusjonelle trekk ved økologisk mjølkedrift, regelverket for økologisk jordbruksproduksjon inkludert. Modellen maksimerer forventa nytte ved ulike holdninger til risiko hos gardbrukeren.

Modellen er en årsplan med start om våren. Beslutninger i steg 1 er antall kyr (ved ulike avdråttsnivå) og kviger i besetninga, hvordan arealet skal fordeles på de forskjellige vekstene (beite, eng til surfôr og bygg) og bruk av husdyrgjødsel (illustrert grafisk i Figur 2.1). Antall kyr kan ikke endres i løpet av året. Modellen tar hensyn til biologiske responssammenhenger som forholdet mellom tilførsel av husdyrgjødsel og fôravlinger og forholdet mellom tilførsel av fôr til kyr og mjølkeavdrått.



Figur 2.1 Modellering av tilpassing under usikkerhet på økologiske mjølkebruk

Kilde: Flaten og Lien (2006)

Faktiske fôravlinger blir ikke kjent før avlingene er i hus om høsten. I modellens steg 2 kan driftsopplegget for resten av året justeres som en respons på hvor store fôravlingene ble (se Figur 2.1). For hver avlingstilstand ble det reknet ut hvor mange oksekalver det lønte seg å beholde over vinteren samt hvor mye fôr en måtte kjøpe og selge.

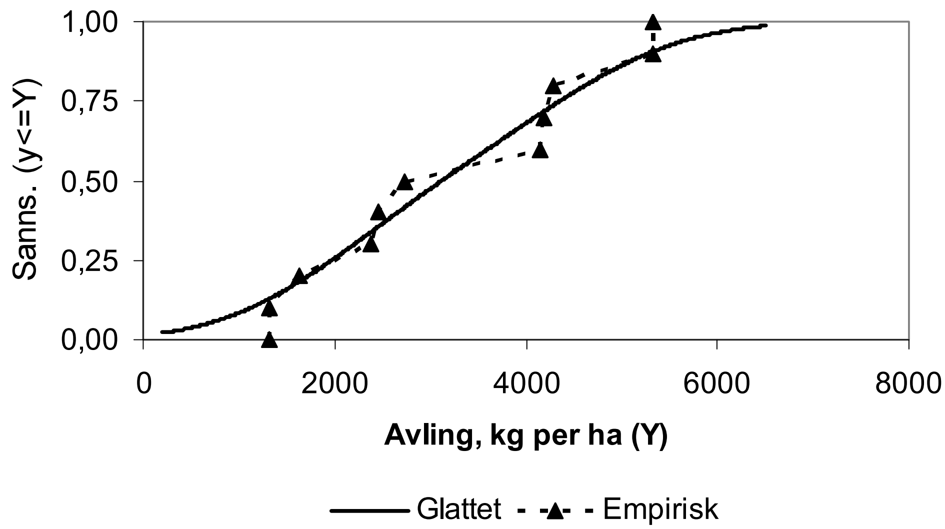
Paneldata fra økologiske mjølkebruk i driftsgranskingene til NILF i perioden 1993–2002 ble nyttet for å berekne historisk samvariasjon i de usikre variablene. Nivå og variasjon for de usikre variablene ble basert på subjektive ekspertanslag. Usikre variable var inntekter fra mjølke- og kjøttproduksjonen samt fôravlingene. Den historiske variasjonen ble bereknet innen bruk mellom år. For både korn- og grovfôravlinger ble det reknet med tre typer fôrår: gode, normale og svake. Dette ga i alt ni tilstander av avlingskombinasjoner. Analysene viste små avlingsforskjeller mellom gode og dårlige år. For inntektsvariablene ble det reknet med ti tilstander.

2.4 Simuleringsmodell

En simuleringsmodell ble spesifisert for å sammenlikne risiko ved økologiske, integrerte[3] og konvensjonelle driftssystem i planteproduksjonen. Avlingsdata fra systemforsøka med åkervekstene korn og potet ved Planteforsk Apelsvoll forskingssenter for perioden 1991–1999 ble benyttet. Disse ble supplert med blant annet priser og tall for arbeidsbehov fra andre datakilder. Bruk på 400 daa ble konstruert for hvert av driftssystema.

Simuleringsmodellen tar hensyn til usikkerhet i avlingsnivå og pris for de enkelte vekster innen hver av de tre driftssystema. Videre tar modellen hensyn til samvariasjon mellom de usikre variablene i modellen (for eksempel om bygg- og havreavlinger i ett driftssystem har en tendens til å være gode eller dårlige i det samme året).

Når forsøksdata benyttes i risikoanalyser, er få dataobservasjoner et velkjent fenomen. Få dataobservasjoner medfører at de empiriske sannsynlighetsfordelingene for de usikre variablene i modellen blir urealistisk «sagbladprega» (dvs. ujamne og lite glatte). Dersom flere observasjoner hadde vært tilgjengelig, ville sannsynlighetsfordelingene ha vært glattere. Simuleringsmodellen tar hensyn til problemet med få dataobservasjoner, ved at det ble utviklet en glatterutine. I simuleringene ble denne benyttet for å glatte jamne ut sannsynlighetsfordelingskurvene, illustrert i Figur 2.2.



Figur 2.2 Empirisk og glattet kumulativ sannsynlighetsfordeling for avling per hektar

Kilde: Lien *et al.* (2006)

[3] Integrert produksjon bygger på en kombinasjon av flere prinsipp, som for eksempel vekstskifte, tiltak mot avrenning, bruk av sprøytemidler i forhold til skadeterskler og mineralgjødsel tilpasset vekstenes behov (Morris og Winter, 1999).

Sannsynlighetsfordelinger for gardbrukers inntekt i de tre driftssystema ble bereknet ved hjelp av simuleringsmodellen. Enkelte gardbrukere er mindre positive til å ta risiko enn andre. Dette har betydning for hvordan gardbrukerne vil rangere driftssystema, eller rettere sagt hvordan de vil rangere sannsynlighetsfordelingene for inntekt i driftssystema. En metode som rangerer sannsynlighetsfordelinger avhengig av brukers holdning til risiko ble benyttet (Hardaker *et al.*, 2004b). Denne tilnærminga gjorde det mulig å sammenlikne driftssystem ved forskjellige holdninger til risiko.

2.5 Videre lesing

Beskrivelse av materiale og metoder for arbeida som bygger på spørreundersøkelsen finnes i de enkelte vitenskapsartiklene (vedlegg 1 – vedlegg 8). Programmeringsmodellen er nærmere beskrevet i artikkelen «Stochastic utility-efficient programming of organic dairy farms» (vedlegg 10). Flere detaljer om simuleringsmodellen er presentert i artikkelen «Comparison of risk in organic, integrated and conventional cropping systems in Eastern Norway» (vedlegg 12).

3 Resultat og diskusjon

3.1 Innledning

I dette kapitlet presenteres og drøftes resultat fra prosjektet. Resultata i kapitlene 3.2–3.5 bygger på spørreundersøkelsen. I kapittel 3.2 sammenliknes risikooppfatninger, driftsopplegg og målsettinger m.m. hos økologiske og konvensjonelle brukere. Kapittel 3.3 undersøker om de nye økologiske mjølkeprodusentene skiller seg fra de som la om tidligere. I kapittel 3.4 vurderes potensialet for omlegging til økologisk drift i Norge. Forskjeller mellom deltids- og heltidsbrukere behandles i kapittel 3.5.

I kapittel 3.6 beskrives resultat fra modellen som vurderer tilpassing under usikkerhet ved økologisk mjølkedrift. Resultat fra simuleringsmodellen presenteres i kapittel 3.7.

3.2 Sammenlikning av konvensjonelle og økologiske brukere

3.2.1 Brukerne og gardsbruka

De økologiske mjølkebruka i spørreundersøkelsen hadde i gjennomsnitt et større jordbruksareal enn de konvensjonelle (Tabell 3.1). Besetningene var om lag like store, men de økologiske kyrne ble tildelt mindre kraftfôr og de mjølket mindre. Arbeidsinnsats og brukers alder var omtrent lik på de konvensjonelle og økologiske mjølkebruka. Økologiske brukere hadde studert i flest år, og flere av dem hadde landbruksutdanning.

Økologiske planteproduksjonsbruk i utvalget hadde et mindre jordbruksareal enn de konvensjonelle, flere av dem hadde husdyr, og de brukte i gjennomsnitt mer enn en tredjedel av arealet til fôrproduksjon (Tabell 3.1). Flere økologiske enn konvensjonelle planteprodusenter hadde høgere utdanning. Det samme gjaldt for landbruksutdanning.

Tabell 3.1 Gjennomsnittstall fra gardsbruk i spørreundersøkelsen (utvalget) sammenliknet med 2002-data fra produksjonstilskottsregisteret (Norge)

	Konvensjonell		Økologisk	
	Utvalget	Norge	Utvalget	Norge
Bruk med mjølkeproduksjon:				
Antall arskyr	16,0	14,7	16,4	15,9
Areal, daa	245	221	294	281
Avdratt, kg mjølk per arsku	6193	6150	5119	5070
Kraftfor, FEm[1)] per arsku	1649	1706	887	866
Arbeid, arsverk	2,1	–	2,1	
Utdanning, %[2)]	17/70/10/3	–	6/55/22/17	
Landbruksutdanning, %	59	–	77	–
Brukers alder, ar	48	52	47	52
Bruk med planteproduksjon:				
Areal, daa	234	209	208	229
Bruk med husdyr, %[3)]	22,4	20,2	56,0	51,0
Korn- og oljevekster, % av arealet	86,3	84,1	47,4	57,6
Eng, % av arealet	7,6	9,3	41,3	34,5
Potet, % av arealet	3,2	3,8	1,5	2,4
Arbeid, arsverk	1,0	–	1,1	–
Brukers alder, ar	50	55	50	56
Utdanning, %[2)]	12/50/20/14	–	11/39/29/21	–
Landbruksutdanning, %	52	–	69	–

1) FEm = forenheter mjølk
2) Grunnskole / videregaende skole / høgskole / vitenskapelig høgskole eller universitet
3) Inkluderer bruk med kjøttfe, hester, fjørfe, griser, sauer og geiter

Kilder: Koesling *et al*. (2004) og Flaten *et al*. (2005)

3.2.2 Mal med gardsdrifta

Fra ei liste med 14 mål med gardsdrifta skulle gardbrukerne velge inntil fem mål som mest viktig. Tabell 3.2 viser rangering av de mest nevnte måla.

Det var tydelige forskjeller mellom økologiske og konvensjonelle brukere. For konvensjonelle produsenter var de klart viktigste måla å ha en sikker og stabil inntekt samt å produsere mat av god kvalitet. Det viktigste målet for økologiske brukere var å drive miljøvennlig og bærekraftig (inkludert å ta vare på kulturlandskapet) foran det å produsere mat av god kvalitet. Størst mulig inntekt ble rangert ganske lågt, og lågest blant de økologiske brukerne. Mjølke- og planteprodusentene hadde temmelig sammenfallende syn på mål med gardsdrifta.

Tabell 3.2 Rangering av de viktigste mala med gardsdrifta

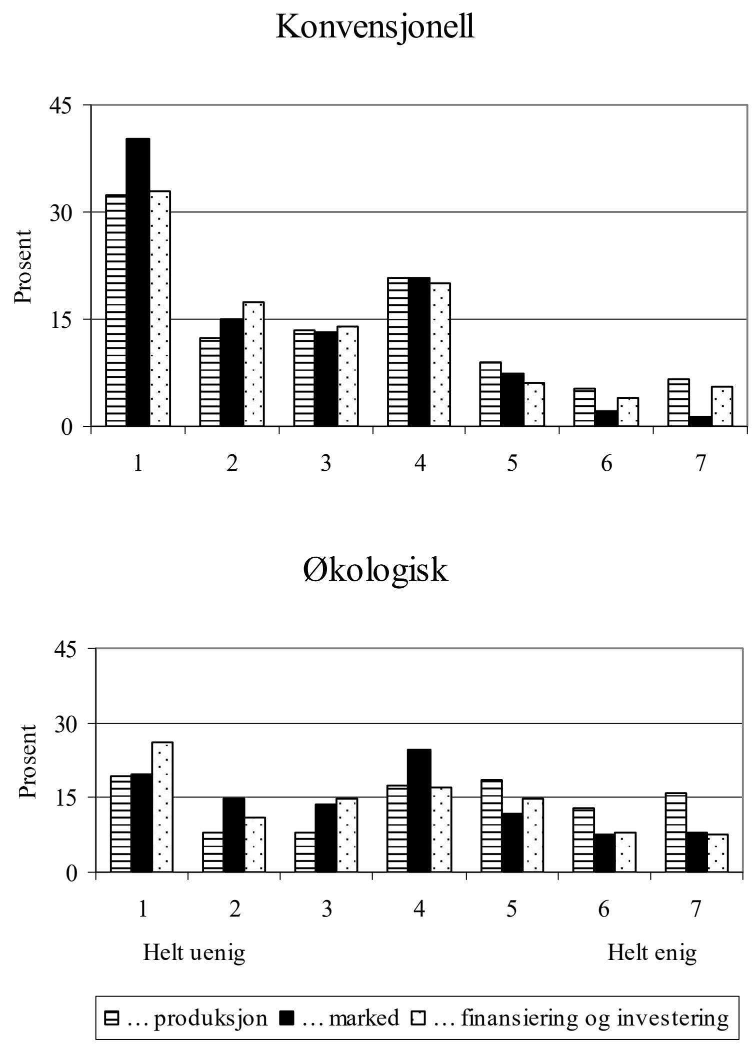
	Mjølkeproduksjon		Planteproduksjon	
Mal	**Økologisk**	**Konv.**	**Økologisk**	**Konv.**
Bærekraftig og miljøvennlig drift, landskapshensyn	1	6	1	5
Produsere mat av god kvalitet	2	2	2	2
Sikker og stabil inntekt	3	1	3	1
Trivsel, oppvekstvilkar for barn, tid til familien	4	4	5	3
Ha et sjølstendig arbeid	5	3	4	6
Forbedre garden til neste generasjon	7	5	6	4

Kilder: Koesling *et al*. (2004) og Lien *et al*. (2004)

Spørreundersøkelsen indikerte, i samsvar med tidligere undersøkelser i andre land (f.eks. Gasson *et al*., 1988; Willock *et al*., 1999; Bergevoet *et al*., 2004), at gardbrukerne har flere mål med gardsdrifta, og ikke ett ensidig mål om høgest mulig inntjening som ofte blir antatt i økonomisk teori og analyse.

3.2.3 Vilje til a ta risiko

De økologiske mjølkeprodusentene anså seg sjøl til å være mer villige til å ta risiko enn sine konvensjonelle kolleger (Figur 3.1). Det samme forholdet ble også funnet hos planteprodusentene. Eller sagt på en annen måte: økologiske produsenter ser på seg sjøl som villige til å satse på noe nytt, men som samtidig har større risiko. På denne måten kan økologiske gardbrukere være mer innovative og nyskapende. Analyser av faktisk brukeratferd i andre land har også vist mindre risikoaversjon blant økologiske enn konvensjonelle brukere (Gardebroek, 2002).



Figur 3.1 Konvensjonelle og økologiske mjølkeprodusenters prosentvise fordeling av risikovilje. Svar på egenvurdering av vilje til å ta risiko innen hhv. produksjon, marked og finansiering og investering på en skala fra 1(helt uenig) til 7 (helt enig)

Kilde: Flaten *et al*. (2005)

3.2.4 Risikokilder

Gardbrukerne skulle angi hvor viktig de oppfattet vesentlige risikokilder for brukets framtidige inntekt. Mjølkebøndene vurderte usikkerhet om tilskottsordninger som viktigst, uansett konvensjonelt eller økologisk driftssystem (Tabell 3.3). Usikkerhet om mjølkeprisen kom på andreplass. Hos plantedyrkerne skåret usikkerhet om produktpriser høgest, foran avlingsvariasjoner. Mange økologiske bønder var opptatt av usikkerheten ved tilskotta til den økologiske driftsformen.

Pris og tilgang på leiejord, usikkerhet om familieforhold og lånemuligheter ble sett på som lite viktige risikokilder. Mjølkebøndene rangerte også variasjon i mjølkeavdrått og produksjonssjukdommer (mastitt, ketose, osv.) langt nede.

Tabell 3.3 Rangering av de viktigste risikokildene

	Mjølkeproduksjon		Planteproduksjon	
Risikokilde	**Økologisk**	**Konv.**	**Økologisk**	**Konv.**
Tilskottsordninger	1	1	4	4
Mjølkepris	2	2	–	–
Tilskottsordninger til økologisk drift	3	–	3	–
Skatte- og avgiftspolitikk	6	3	8	3
Priser pa planteprodukt	16	17	1	1
Salgsavlinger i planteproduksjonen	15	23	2	2

Kilder: Koesling *et al*. (2004) og Flaten *et al*. (2005)

Konvensjonelle brukere vurderte priser på driftsmidler og anleggsmidler som større risikokilder enn de økologiske. Denne forskjellen skyldes trolig at økologiske driftssystem nytter mindre av innkjøpte driftsmidler. Flere konvensjonelle enn økologiske mjølkeprodusenter var opptatt av usikkerhet om regelverk vedrørende dyrevelferd. Mindre frykt hos de økologiske brukerne kan skyldes allerede strenge krav til dyrevelferd i økologisk dyrehold. Antakelig påvirket usikkerhet knyttet til den kommende dyrevelferdsmeldinga (Landbruksdepartementet, 2002) vurderingene. Konvensjonelle planteprodusenter var mer bekymret for varierende produktpriser enn de økologiske.

De økologiske produsentene var meget opptatt av risikokilder tilknyttet vilkår for økologisk drift: tilskott til økologisk drift, merpris for økologiske produkt og regelverk for økologisk drift. Av disse ble usikkerheten om tilskottsordningene oppfattet som størst. Den relativt store betydningen av forandringer i det økologiske regelverket, kan ses i sammenheng med at regelverket har vært under utvikling og er blitt endret flere ganger de siste 10–15 åra.

Politikk ble oppfattet som viktigste risikokilde, faktisk viktigere enn forbrukernes etterspørsel, risiko for dyre- og plantesjukdommer, og den uunngåelige risikoen knyttet til dårlig vær. Politisk risiko handlet om mer enn usikre priser og tilskott. Skatte- og avgiftspolitikk, mjølkekvoteregelverk, dyrevelferdskrav, miljøkrav, osv. ble også rangert høgt. Mange gardbrukere påpekte på eget initiativ internasjonale forhold (EU og WTO) som viktige risikokilder. Bruksstørrelse, alder, utdanning og lokalisering betydde lite for hvor viktig gardbrukerne oppfattet politisk risiko. Med økende andel kornareal ble plantedyrkere mer opptatt av politisk risiko.

Blant anna fordi jordbruksdrift er risikofylt, har myndighetene i mange land gått inn med tiltak for å stabilisere jordbruksinntektene. Disse tiltaka har redusert markeds- og produksjonsrisikoen, men det et paradoks at politisk risiko oppfattes som den viktigste risikokilden for framtidig inntekt.

Høgt støttenivå og betydelige reguleringer er ikke ensbetydende med stor politisk risiko. Men i kombinasjon med mangel på langsiktighet, stabilitet og forutsigbarhet kan landbrukspolitikken bli oppfattet som en viktig risikokilde. Internasjonalt press om avregulering, friere flyt av mat over landegrensene og tilhørende frykt for kutt i jordbruksstøtten og forverret økonomi er en annen forklaringsfaktor. Videre fører langvarige politikkendringer til større risiko enn år til år variasjoner i markeder og vekstforhold, fordi mange dårlige år på rad kan forårsake store inntektstap, eiendeler kan miste verdi og driftsøkonomien kan ramle fullstendig sammen (Just, 2003).

3.2.5 Risikohandtering

Gardbrukerne skulle vurdere viktigheten av en rekke tiltak for å handtere risiko. Vurdering av tiltak for å handtere risiko var mer lik for økologiske og konvensjonelle brukere enn oppfatning av risikokilder. God likviditet/betalingsevne (for å kunne betale rekninger ved forfall) ble vurdert som det viktigste tiltaket for å handtere risiko. Mjølkebøndene hadde forebygging av husdyrsjukdommer på andreplass, mens plantedyrkerne ville forebygge sjukdommer og skadedyr hos planter. Andre viktige tiltak var kjøp av landbruksforsikring samt å produsere til lågest mulig kostnad.

Tabell 3.4 Rangering av de viktigste strategier for a handtere risiko

	Mjølkeproduksjon		Planteproduksjon	
Strategi	**Økologisk**	**Konv.**	**Økologisk**	**Konv.**
God likviditet	1	1	1	1
Forebygge husdyrsjukdommer	2	2	9	12
Kjøp av landbruksforsikring	3	3	3	4
Produsere til lagest mulig kostnad	5	4	5	5
Forebygge skadedyr og plantesjukdommer	7	8	2	2
God soliditet	9	7	10	3

Kilder: Koesling *et al*. (2004) og Flaten *et al*. (2005)

Organisering av bruket som aksjeselskap, investeringer utenfor bruket og å ha ekstra maskinkapasitet ble sett på som de minst viktige strategiene for å handtere risiko.

Flere konvensjonelle enn økologiske mjølkeprodusenter la vekt på bruk av veterinære rådgivingstjenester, fellestiltak for å redusere prissvingninger (for eksempel ved å delta i landbrukssamvirke) samt god soliditet (dvs. lite gjeld og stor formue/egenkapital). For økologiske plantedyrkere var fleksibilitet og allsidighet i driftsopplegget viktigere enn for de konvensjonelle. Konvensjonelle plantedyrkere oppfattet god soliditet og investeringer utenfor bruket som viktigere enn de økologiske.

De som var mest bekymret for politisk risiko var mest opptatt av økonomiske tiltak som å ha god likviditet og soliditet samt å produsere til låg kostnad. Andre og mer kreative måter å handtere politisk risiko enn de som ble undersøkt kan være nødvendig (Miller *et al*., 2004). Uansett har den enkelte bonde liten «styring» med politiske beslutninger, og det er ikke mulig å forsikre seg mot endringer i politiske vilkår for jordbruksdrift. Men kanskje de kan samhandle med yrkeskolleger for å påvirke politikken i en mer stabil og forutsigbar retning?

3.2.6 Kan politikken gjøres mer forutsigbar?

Næringsutøvere må rekne med å leve med en viss politisk risiko. Men oppfatningene om stor politisk risiko, som undersøkelsen tyder på, bidrar neppe til en best mulig ressursbruk i næringa. Og usikkerhet om framtidige politiske vilkår bidrar til å dempe investeringer i kapitalkrevende, irreversible utbyggingsprosjekt (Pietola og Myers, 2000).

Kan det gjennomføres tiltak for å gjøre politikken mer forutsigbar? Spørreundersøkelsen gikk ikke inn på det feltet. Men hvis det er ønskelig å moderere politiske risiko for næringsutøvere, synes det nødvendig med langsiktige, stabile og forutsigbare vilkår for næringsdrift. Politikere bør være forsiktig med hyppige, brå og ustadige endringer i vilkår for jordbruksdrift. Tiltak som gir gardbrukere større sikkerhet om framtidige vilkår bør vurderes. Ett skritt i en mer forutsigbar retning kan være å gå over fra ettårige til flerårige jordbruksavtaler. Videre kan politikkendringer, f.eks. ved skjerpa dyrevelferds- eller miljøkrav, varsles i god tid og på en måte som gjør at de passer inn i en normal investeringssyklus på et gardsbruk.

3.2.7 Husdyrhelse og helsehandtering

Det var klare forskjeller mellom økologiske og konvensjonelle mjølkekubesetninger med hensyn til oppfatninger av helseforhold til dyra i de to driftsformene, registrert husdyrhelse og helsehandtering.

Omlag 80 % av de økologiske brukerne var uenige i at konvensjonell produksjon fremmer dyrehelsa, mens bare 19 % av de konvensjonelle var uenige i dette utsagnet. Mer enn 70 % av de økologiske brukerne mente at økologisk dyrehold tar bedre vare på husdyras naturlige behov, mens bare 10 % av de konvensjonelle brukerne var enige i dette.

For de fleste typer sjukdommer var det færre registrerte behandlinger i de økologiske besetningene (Tabell 3.5). For mjølkefeber, børbetennelse og brunstsynkronisering kunne det ikke påvises noen forskjeller mellom økologiske og konvensjonelle besetninger. I økologiske besetninger var behandlingsfrekvensen for alle sjukdommer bare 60 % av hva som ble funnet i de konvensjonelle besetningene. Antall mastittbehandlinger bidro mest til forskjellen mellom driftsformene.

Flere økologiske enn konvensjonelle brukere brukte alternativ behandling (f.eks. homøopati og naturmedisin), og de utførte oftere egenbehandling (f.eks. hyppig utmjølking).

Begge gruppene oppgav at de ikke noterte all egenbehandling i helsekorta. Helsekortdataene var derfor ikke fullstendige, og de viste ikke det hele og sanne bildet av sjukdomstilfeller og behandlinger i norske mjølkekubesetninger.

Tabell 3.5 Gjennomsnittstall for helse- og reproduksjonsrelaterte variabler fra helsekort-registreringer i konvensjonelle og økologiske mjølkekubuskaper

	Konvensjonell	Økologisk	Signifikans[1)]
Geometrisk celletall, ×1000/ml	117,7	126,4	
Kalvingsintervall, dager	390	388	
Utrangering, % av kyr	43,0	36,6	*
Behandling, alle sjukdommer, per 100 kyr	72,1	44,2	*
Beh., alle mastitter, per 100 kyr	30,7	17,7	*
Beh., akutte mastitter, per 100 kyr	19,5	11,7	*
Beh., kliniske mastitter, per 100 kyr	30,2	17,5	*
Beh., subkliniske mastitter, per 100 kyr	11,0	5,9	*
Beh., spenetrakk, per 100 kyr	2,9	1,3	*
Beh., mjølkefeber, per 100 kyr	5,4	4,8	
Beh., ketose, per 100 kyr	6,3	3,4	*
Beh., etterbyrd, per 100 kyr	2,8	1,8	*
Beh., børbetennelse, per 100 kyr	0,7	0,6	
Beh., brunstmangel, per 100 kyr	2,4	0,6	*
Beh., brunstsynkronisering, per 100 kyr	0,4	0,2	
Beh., eggstokkcyster , per 100 kyr	1,2	0,3	*

1) Signifikant forskjellig ifølge *t*-test ved $p<0,05$

Kilde: Valle *et al*. (2005)

Når helsekortdataene ble korrigert for hvor mange av sjukdomstilfella husdyrbrukerne tilkalte veterinær til, var det bare forskjell mellom de to gruppene når det gjaldt forekomst av akutt mastitt, dvs. færre mastittbehandlinger i økologiske besetninger (Tabell 3.6). Denne ulikheten forsvant når det ble korrigert for avdråttsnivå. Det ser derfor ut til at færre mastittbehandlinger i økologiske enn konvensjonelle besetninger i sin helhet kan forklares med lågere mjølkeavdrått.

Resultata understreker behovet for kritisk å vurdere registerte helsedata ved sammenliknende studier av sjukdomstilfeller i husdyrholdet.

Tabell 3.6 Gjennomsnittstall for helsevariabler fra helsekortordninga justert for andelen av helseavvik som veterinær tilkalles til

	Konvensjonell	Økologisk	Signifikans[1)]
Akutte mastitter, per 100 kyr	22,0	15,3	*
Mildere mastitter , per 100 kyr	125,3	108,3	
Kroniske mastitter, per 100 kyr	51,5	43,1	
Ketose, per 100 kyr	9,8	8,7	
Mjølkefeber, per 100 kyr	6,0	5,8	

1) Signifikant forskjellig ifølge *t*-test ved $p<0,05$

Kilde: Valle *et al*. (2005)

Videre lesing

Sammenlikning av målsettinger, risikovilje, risikokilder, risikostyring i økologisk og konvensjonell mjølkeproduksjon er beskrevet i artiklene «Risk and risk management in organic and conventional dairy farming: Empirical results from Norway» (vedlegg 1) og «Comparing risk perceptions and risk management in organic and conventional dairy farming: empirical results from Norway» (vedlegg 3). Den siste artikkelen er mest grundig og fullstendig, men også noe mer teknisk. Tilsvarende emner i plantedyrking er beskrevet i artikkelen «Risk and Risk Management in Organic and Conventional Cash Crop Farming in Norway« (vedlegg 2). Ei kort populærframstilling finnes i kronikken «Uforutsigbar landbrukspolitikk?» i Nationen 6. juli 2004 (http://www.nationen.no/meninger/Kronikk/-article1173338.ece).

I artikkelen «Herd health, health management and animal welfare implications in organic versus conventional dairy herds in Norway», se vedlegg 4, er forhold rundt helsehandtering, registrerte behandlinger for sjudom i helsekortdatabasen og egen helsehandtering i økologisk og konvensjonell mjølkeproduksjon, gjort rede for i detalj.

3.3 Skiller de nye økoprodusentene seg fra den «eldre garden»?

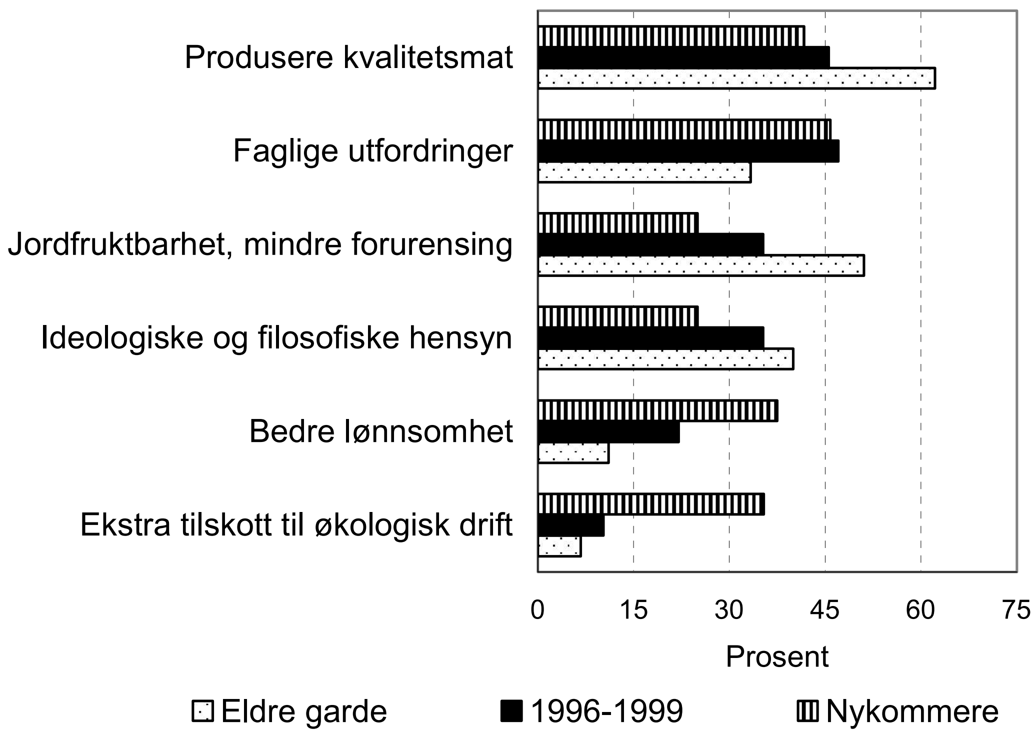
Økologisk jordbruk er i vekst. Det meste av veksten skyldes at konvensjonelle bønder legger om til økologisk drift, ofte stimulert av økte pristillegg i markedet og ekstra tilskott till økologisk drift. Med økt popularitet er det hevda at det økologiske jordbruket står i fare for å miste identiteten sin og blir en del av det etablerte matvaresystemet, ved at økologisk driftspraksis og former for vareomsetning blir mer lik konvensjonell produksjon, også kalt «konvensjonalisering» (Guthman, 2004).

Det ble undersøkt om trekk ved gardsdrifta, målsettinger, motiv for omlegging og holdinger hos nyere økologiske brukere skiller seg fra de som var tidligere ute. Produsentene ble delt inn i tre grupper etter omleggingstidspunkt: De som la om til økologisk drift i 1995 eller tidligere («den eldre garden»), de som la om i perioden 1996 til 1999 og de som la om i 2000 eller senere (nykommerne). Undersøkelsen ble avgrenset til mjølkeprodusenter.

Gjennomsnittsalderen på brukerne var 47 år, og de hadde i gjennomsnitt 23 år med landbrukserfaring. Nykommerne var yngre og de hadde færre år med landbrukserfaring enn de tidligere gruppene. Den eldre garden hadde mer utdanning enn nykommerne.

Noen funn tydet på ei mer pragmatisk drift hos nykommerne. Mange i den eldre garden fulgte den økologiske grunnidéen med et allsidig plante- og husdyrhold og i større grad et sjølbergingshushold. Nykommerne var oftere spesialiserte mjølkeprodusenter. Samtidig fôret de kyrne sterkest med kraftfôr, kyrne mjølket mer og ble oftere behandlet av veterinær mot sjukdom. Færre nykommerne enn de som var tidligere ute med å legge om brukte alternativ veterinærmedisin.

Bedre lønnsomhet og ekstra tilskott til økologisk drift var ei mye viktigere drivkraft for å legge om blant nykommerne enn de andre (Figur 3.2). De som var tidligere ute med økologisk drift la større vekt på hensyn til miljø samt økologisk ideologi og filosofi. For eksempel svarte bortimot 70 % av nykommerne at miljøvennlig og bærekraftig drift var et viktig mål, mens andelen hos den «eldre garden» var hele 90 %. Målet om å ha nok fritid var viktigere blant nykommerne enn hos de som var tidligere ute. Det samme gjaldt størst mulig inntekt, et mål de tidligere gruppene rangerte svært lågt.



Figur 3.2 Viktige motiv for å legge om til økologisk drift, gruppert etter tidspunkt for omlegging. Prosent brukere som rangerte motivet som ett av de tre viktigste.

Kilde: Flaten *et al.* (2006)

Andre funn tydet likevel på en ganske låg grad av «konvensjonalisering». Størstedelen av besetningene, også blant de nye, hadde en låg til moderat mjølkeavdrått. Sjøl om bortimot 40 % av nykommerne la vekt på økonomi, var fortsatt hensyn til miljø, bærekraft og matvarekvalitet mer framtredende som målsettinger og motiv for å legge om. Alle gruppene hadde et positivt syn på miljøkvalitetene ved økologisk drift, men trua var sterkest i den eldre garden.

Tilstrømminga av nye økologiske aktører ser ut til å øke innslaget av pragmatiske, økonomiske orienterte brukere. En må rekne med spenninger mellom disse og de tradisjonelle idealistene i synet på hva som er «sunn» økologisk gardsdrift, samt at de vil reagere forskjellig på endringer i priser, landbrukspolitiske tiltak og økologisk regelverk. Dersom økonomien strammes til, må det forventes at de som bare legger om av økonomiske hensyn lettere går tilbake til konvensjonell drift enn de som er engasjert i større deler av det økologiske verdigrunnlaget.

Videre lesing

Resultat er nærmere beskrevet i artikkelen «Do the new organic producers differ from the 'old guard'? Empirical results from Norwegian dairy farming» (vedlegg 5). Ei kort populærframstilling finnes under oppslaget «Skil dei nye økoprodusentane seg frå den 'eldre garden'?» på nettsidene til NILF (http://www.nilf.no/Forsiden/Nn/2005/S20050413-Okoprodusenter.shtml).

3.4 Potensialet for omlegging til økologisk drift

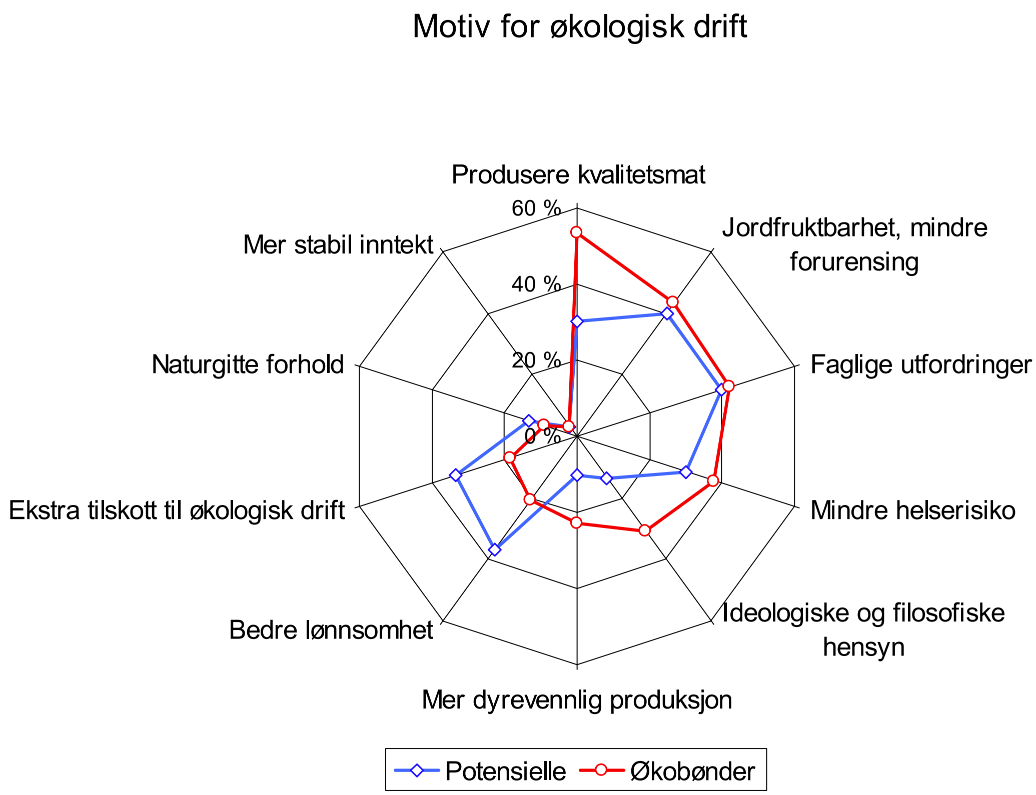
For å kunne nå myndighetenes økologiske produksjonsmål må mange gardbrukere finne det interessant å legge om til og opprettholde økologisk drift. Samtidig bør ikke mange av de nåværende økologiske brukerne gå tilbake til konvensjonell drift.

De konvensjonelle brukerne ble spurt om de har planer å legge om til økologisk drift innen 2009. For 74 % av dem var det uaktuelt med økologisk produksjon, 4 % uttrykte at de ville legge om hele eller deler av jordbruksareala, mens 18 % var usikre på hva de ville gjøre. Bare 2 % av de økologiske bøndene uttrykte at de ville gå tilbake til konvensjonell drift.

I 2004 ble 3,3 % av jordbruksarealet drevet økologisk. Hvis 4 % av de konvensjonelle bøndene (i 2003) virkelig legger om helt eller delvis, kan den økologiske arealandelen øke til 6–7 %. Dersom myndighetenes mål om 10 % økologisk jordbruksareal innen utgangen av 2009 skal nås, må minst hver fjerde av de usikre legge om. Samtidig kan ikke mange gå tilbake til konvensjonell drift. Det nyeste målet om 15 % av *matproduksjonen* som økologisk innen 2015 synes mer besværlig, siden det vil kreve at minst halvparten av de usikre legger om.

For de som ville legge om til økologisk drift var viktigste motiv: 1) bedre jordfruktbarhet og mindre forurensing, 2) interessante faglige utfordringer, 3) bedre lønnsomhet og 4) ekstra tilskott til økologisk drift. I forhold til de som allerede drev økologisk var bedre lønnsomhet og ekstra tilskott til økologisk drift blitt viktigere hensyn, mens produksjon av kvalitetsmat, ideologi og filosofi betydde mindre (Figur 3.3). Viktigste motiv for å drive konvensjonelt hos de som utelukket økologisk drift var muligheter for mer effektiv produksjon, bedre lønnsomhet, en mer stabil inntekt og merarbeidet ved økologisk drift.

Det ble konkludert med at ensidig satsing på økonomiske tiltak som produksjonstilskott og pristillegg neppe er tilstrekkelig for å få nok brukere til å legge om, slik at myndighetenes produksjonsmål kan nås. Målrettet innsats på andre områder, inkludert veiledning om hvordan praktiske utfordringer ved økologisk drift kan løses, må også være på plass. Siden ei omlegging krever tid og penger, er det viktig at økonomiske vilkår og regelverk for drifta er forutsigbare.



Figur 3.3 Motiv for økologisk drift hos økologiske brukere og de som uttrykte at de ville legge om (potensielle). Prosent brukere som rangerte motivet som ett av de tre viktigste.

Kilde: Koesling *et al*. (2005)

Videre lesing

Resultata er nærmere beskrevet i artikkelen «Motives and potential for conversion to organic farming in Norway» (vedlegg 6). Ei enklere framstilling kan leses i den populærvitenskapelige artikkelen «Hvem blir de nye økobøndene? (vedlegg 7). Ei kort framstilling er gitt i pressemeldinga «Økt innsats må til for å nå økologisk arealmål» på nettsidene til NORSØK (http://www.norsok.no/presse/presse130705.htm).

3.5 Forskjeller mellom deltids- og heltidsbrukere

En økende andel av norske gardsbruk drives på deltid. Deltidsbrukerne ble stilt spørsmål om motiv for å arbeide utenfor bruket. Videre ble driftspraksis, motiver og risikooppfatninger på heltids- og deltidsbruk sammenliknet.

For enslige ble det ansett som deltidsdrift hvis brukeren hadde minst 15 % stilling utenfor bruket. For gifte eller samboende måtte begge ha minst 15 % stilling utenfor bruket for at det skulle reknes som deltid. Om lag 57 % av plantebruka og 17 % av mjølkebruka ble kategoriserte som deltidsbruk.

Både plante- og mjølkeprodusentene mente at de viktigste årsakene til å arbeide utenfor bruket var å øke familiens inntekt samt å ha en mer stabil inntekt. Planteprodusentene vurderte utnytting av ledig arbeidskapasitet høgere enn mjølkeprodusentene. Et ønske om å arbeide med noe annet var lite viktig. Deltidsbøndene var yngre og hadde mer utdanning enn heltidsbøndene.

Det ble avdekket betydelige forskjeller mellom heltids- og deltidsbrukere i mål med gardsdrifta, risikooppfatninger og strategier for risikostyring. Det viktigste målet med gardsdrifta for heltidsbønder og deltids planteprodusenter var å produsere mat av god kvalitet, mens for deltids mjølkebønder var sikker og stabil inntekt viktigst. Å produsere mat av god kvalitet og forbedre garden til neste generasjon var viktigere for heltids enn for deltids mjølkebønder. Deltidsbrukere med planteproduksjon var mindre opptatt av å ha et sjølstendig arbeid enn heltidsbrukere med planteproduksjon og mjølkeprodusenter.

Usikkerhet rundt tilskottsordninger og landbrukspolitikk var viktigste risikokilde for begge typer mjølkeprodusenter. For planteprodusenter var pris- og avlingsvariasjon de hyppigst nevnte risikokilder.

Å ha god likviditet, redusere/hindre sjukdommer og skadedyr var viktige tiltak for å handtere risiko. Deltidsbrukere vurderte i mye større grad enn heltidsbrukere, arbeid utenom bruket som en strategi for å handtere risiko. For deltids planteprodusenter var arbeid utenfor bruket den viktigste strategien for å redusere risiko. Deltids- og heltidsbrukere hadde likevel ikke forskjellige oppfatninger av støtteordninger og priser som risikokilder.

Deltidsbrukere, i motsetning til heltidsbrukere, anså rådgivingsapparatet og til dels forsikringer som mindre viktige strategier for å handtere risiko. Arbeid utenfor bruket var viktigste risikostrategi for planteprodusenter på deltid. Flere deltidsbrukere enn heltidsbrukere hadde planer om å redusere gardsdrifta, noe som kan være nødvendig for å kunne klare en situasjon med flere jobber.

Videre lesing

Resultata er nærmere beskrevet i artikkelen «Management and risk characteristics of part-time and full-time farmers in Norway» (vedlegg 8). Ei populærframstilling om de økologiske mjølkeprodusentene finnes i populærartikkelen «Hel- og deltid i økologisk mjølkeproduksjon» (vedlegg 9).

3.6 Tilpassing under usikkerhet ved økologisk mjølkedrift

Fra 25. august 2005 er hovedregelen i økologisk mjølke- og kjøttproduksjon 100 % økologisk fôr. Før den tid kunne det brukes inntil 15 % fôr av ikke-økologisk opprinnelse til økologiske drøvtyggere. Det nye regelverket vil direkte påvirke prisen på innkjøpt fôr, siden økologisk kraftfôr koster over ei krone mer per kg enn tilsvarende konvensjonelt fôr. Modellen ble brukt til å undersøke hvordan økologiske mjølkeprodusenter kan tilpasse driftsopplegg til det nye regelverket på en mest mulig lønnsom måte, samt hvilke økonomiske konsekvenser en kan vente seg.

Modellen fant optimal driftspraksis og økonomisk resultat – før og etter kravet om 100 % økologisk fôr. To brukstyper, begge med en kvote på 100 000 liter mjølk, ble modellert. Det ene bruket disponerte 400 daa jord, det andre 220 daa.

For bruket på 400 daa ble mjølkekvoten opprinnelig fylt med 21 kyr, hver med en avdrått på 5 500 kg mjølk. Det ble tilført mest husdyrgjødsel i byggåkrene. Oksekalvene ble beholdt over beitesesongen. De viktigste justeringene i steg to (om høsten) var å selge noen oksekalver etter svake avlingsår, mens det ble solgt surfôr etter gode avlingsår. Det nye regelverket førte ikke til noen endringer i drifts-opplegget, bortsett fra at 17 tonn innkjøpt konvensjonelt kraftfôr ble direkte erstattet med innkjøpt økologisk kraftfôr.

I brukssituasjonen med mindre arealtilgang (220 daa) ble kvoten opprinnelig fylt med 16 høgtytende kyr (7 000 kg). Kyrne ble tildelt mer kraftfôr enn på bruket med 400 daa, og opptaket av grovfôr ble lågere. Oksekalvene ble bare beholdt over beitesesongen. Surfôr ble kjøpt inn i alle typer avlingsår, og mest i de svake.

Bruket på 220 daa tilpasset seg det nye fôrkravet på flere måter. Det lønte seg å gi kyrne mindre kraftfor og hver ku mjølket 400 kg mindre enn tidligere. Endringene skyldtes dyrere økologisk kraftfôr. Bare 93 % av mjølkekvoten ble produsert. Bruket kjøpte inn 9 tonn mindre kraftfôr enn tidligere.

Sjøl om de to brukstypene tilpasset seg det nye fôrkravet forskjellig, var de økonomiske konsekvensene temmelig like. Begge fikk et inntektstap på bortimot 20 000 kroner i året ved at de ikke lenger kunne nytte inntil 15 % av fôret som billigere ikke-økologisk fôr. For å unngå høgt forbruk av dyrt økologisk kraftfôr, må også gardbrukere passe ekstra på kvaliteten på grovfôret og kalvingstida.

Videre lesing

Resultat fra anvendelsen av optimeringsmodellen på det nye regelverket for ikke-økologisk fôrandel finnes i artikkelen «Organic dairy farming in Norway under the 100 % organically produced feed requirement» (vedlegg 11). Ei kort populær-framstilling finnes under oppslaget «Økologisk mjølkeproduksjon, tilpasning til krav om 100 % økofôr» på nettsidene til NILF (http://www.nilf.no/Forsiden/Bm/2005/S20050706-Okologisk.shtml).

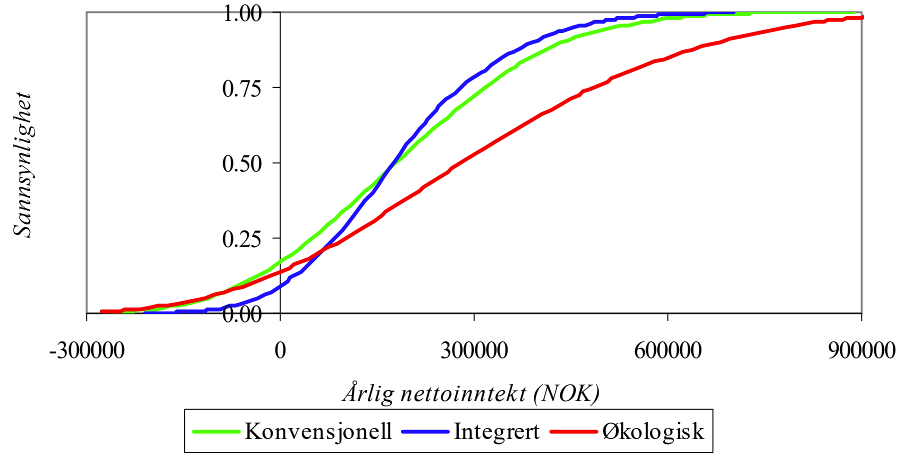
3.7 Risiko i plantedyrkingssystem

Risiko ble antatt å være et viktig forhold ved gardbrukers valg av driftssystem for planteproduksjon. Det var grunn til å tro at driftsystema kunne gi forskjellig resultat under samme værforhold. For eksempel kan restriksjoner i bruk av plantevern-midler og lettløselig mineralgjødsel føre til et annet risikobilde i økologisk sammen-liknet med konvensjonell eller integrert drift. I tillegg kan mindre utvikla markeder for økologiske varer gjøre produktprisene mer ustabile.

Simuleringsstudien for et bruk med 400 daa bekreftet antakelsene. Konvensjo-nell drift ga størst avlinger. Ved integrert drift var avlingene nær 90 % av det konvensjonelle. Økologiske avlinger utgjorde bare 60–65 % av de konvensjonelle.

Variasjoner i avlinger mellom år var derimot størst ved økologisk dyrking, mens konvensjonell og integrert drift lå på om lag samme nivå.

Inntektsvariasjonen mellom år var også størst i det økologiske driftssystemet, illustrert i Figur 3.4. Siden det økologiske driftssystemet viste den flateste sannsynlighetsfordelinga for brukers nettoinntekt, var det størst økonomisk usikkerhet ved økologisk drift. Men samtidig viser Figur 3.4 at økologisk drift ga best økonomisk resultat i mer enn 75 % av åra.



Figur 3.4 Simulerte kumulative sannsynlighetsfordelinger for årlig nettoinntekt (i kroner) i driftssystema. Bruksstørrelse 400 daa

Kilde: Lien *et al.* (2006)

Metoden for å sammenlikne driftsystema ved forskjellige holdninger til risiko ble benyttet. Gitt nåværende tilskottsordninger og økologiske pristillegg, viste det seg at økologisk produksjon var økonomisk mest gunstig under dyrkingsvilkår som ved Apelsvoll. Dette gjaldt også for brukere med sterk motvilje mot å ta risiko.

Integrert og konvensjonell drift hadde tilnærmet samme økonomiske resultat. Dette antydet at gevinsten ved høgere konvensjonelle avlinger kan bli utliknet av sparte kostnader til jordarbeiding, gjødsel og plantevernmidler i et integrert dyrkingssystem.

Sjøl om nåværende tilskottsordninger for økologisk drift skulle bli knappet inn på eller falle bort, viste resultata at økologisk dyrking fortsatt var økonomisk fordelaktig. Dette gjaldt også for brukere som sterkt misliker risiko. Falt også de økologiske pristilleggga bort, ble økologisk drift klart mindre gunstig enn de to andre systema.

Kombinasjonen av lågere og mer usikre avlinger, usikkerhet om framtidige tilskottsordninger og pristillegg for økologisk planteprodukter kan gjøre at mange gardbrukere reserverer seg mot å legge om til økologisk drift. Samla risiko ved økologisk drift kan være et anselig argument mot omlegging, særlig for lite risikovillige brukere.

Videre lesing

Resultata er nærmere beskrevet i artikkelen «Comparison of risk in organic, integrated and conventional cropping systems in eastern Norway» (vedlegg 12). En kort populærframstilling finnes under oppslaget «Risiko i økologisk, integrert og konvensjonell planteproduksjon» på nettsidene til NILF (http://www.nilf.no/Forsiden/Bm/2005/S20050310-Risiko.shtml).

4 Konklusjoner

Hovedmålet med dette prosjektet var å øke kunnskapen om risiko og risikohandtering innenfor økologisk jordbruksproduksjon i Norge.

Ut fra drøftingene i denne samlerapporten og de vedlagte artiklene kan vi trekke følgende konklusjoner:

- Flere økologiske enn konvensjonelle brukere uttrykte vilje til å ta risiko.
- Politiske forhold ble oppfattet som alvorligste risikokilde for konvensjonelle så vel som økologiske brukere, viktigere enn forbrukernes etterspørsel, risiko for dyre- og plantesjukdommer, og den uunngåelige risikoen knyttet til dårlig vær. Politisk risiko handlet om mer enn usikre priser og tilskott: Skatte- og avgiftspolitikk, mjølkekvoteregelverk, dyrevelferdskrav, miljøkrav osv. ble også rangert høgt. Bruksstørrelse, alder, utdanning og lokalisering betydde lite for hvor viktig gardbrukerne oppfattet politisk risiko. Plantedyrkere ble mer opptatt av politisk risiko etter hvert som andelen kornareal økte. For å moderere politisk risiko synes det viktig med langsiktige, stabile og forutsigbare vilkår for næringsdrift.
- Gardbrukerne vurderte god likviditet som det viktigste tiltaket for å handtere risiko. Å forebygge sjukdommer og skadedyr hos dyr og planter kom på andreplass. Andre viktige tiltak var kjøp av landbruksforsikring samt å produsere til låg kostnad. De brukerne som var mest urolig for politisk risiko var mest opptatt av økonomiske tiltak som å ha god likviditet og soliditet samt å produsere til låg kostnad.
- Høgest rangerte mål med gardsdrifta for konvensjonelle brukere var å ha en sikker og stabil inntekt samt å produsere kvalitetsmat. Viktigst for de økologiske bøndene var å drive miljøvennlig og bærekraftig (inkludert å ta vare på kulturlandskapet) foran det å produsere kvalitetsmat.
- Økologiske mjølkekyr hadde færre registrerte sjukdomsbehandlinger enn konvensjonelle kyr. Økologiske produsenter var mer aktive med egenbehandling

enn de konvensjonelle, og flere av de økologiske brukerne benyttet alternativ veterinærmedisin. Egenbehandlinger ble ikke alltid notert i helseregistreringene. Etter at det ble korrigert for forskjeller i helsehandtering mellom konvensjonelle og økologiske brukere, var det ingen klare tegn på at økologisk husdyrhold ga helsegevinster. Det var færre mastittforekomster ved økologisk drift, men dette hadde direkte sammenheng med et lågere avdråttsnivå hos økologiske kyr.

- De nye økologiske mjølkeprodusentene hadde et mer pragmatisk syn på økologisk drift og filosofi enn de som var tidlig ute med å legge om. Driftsopplegget hos nykommerne var mindre allsidig, og husdyrholdet ble drevet mer intensivt. «Veteranene» la stor vekt på miljøhensyn, økologisk ideologi og filosofi. Hos de nye økologiske brukerne var hensynet til bedre lønnsomhet og ekstra tilskott til økologisk drift ei mye viktigere drivkraft for å legge om. Men flertallet av brukerne, også blant nykommerne, uttrykte et betydelig engasjement for den økologiske driftsformen.
- Fire prosent av de konvensjonelle brukerne uttrykte planer om å legge om hele eller deler av garden til økologisk drift innen 2009. Nesten 75 % utelukket å legge om, mens 18 % var usikre. For å kunne nå 10 % økologisk jordbruksareal innen 2009 må alle med omleggingsplaner og hver fjerde av de usikre virkelig legge om til økologisk drift. Samtidig bør bare et fåtall gå tilbake til konvensjonell drift. Målet om 15 % av produksjonen som økologisk innen 2015 synes enda mer krevende.
- For å få brukere til å legge om til økologisk drift trengs bl.a. økonomisk stimulans, veiledning om hvordan praktiske driftsutfordringer kan løses og langsiktige, stabile og forutsigbare økonomiske rammevilkår og regelverk.
- Uten å skille mellom konvensjonell og økologisk drift, ble heltids- og deltidsbrukere sammenliknet. Høgere og mer stabil husholdsinntekt var de viktigste grunner til å ta arbeid utenfor bruket. Heltids- og deltidsbrukere hadde forskjellige mål med gardsdrifta, risikooppfatninger og strategier for risikostyring. For planteprodusenter på deltid var arbeid utenfor bruket den viktigste strategien for å redusere risiko. Flere deltidsbrukere enn heltidsbrukere hadde planer om å produsere mindre på garden.
- Det ble utviklet en modell av typen diskret stokastisk programmering for å finne optimal drift og økonomisk resultat under usikkerhet på økologiske mjølkebruk. Tall fra økologiske mjølkebruk i driftsgranskingene til NILF ble nyttet for å berekne historisk samvariasjon mellom usikre variable.
- Optimeringsmodellen ble brukt for å undersøke hva som skjer på mjølkebruk når alt fôr må være økologisk, jf. krav gjeldende fra august 2005. To brukstyper ble undersøkt, begge med en mjølkekvote på 100 000 liter, men med ulikt arealgrunnlag. Det ene bruket erstattet alt konvensjonelt kraftfôr med økologisk, det andre produserte mindre mjølk. Begge brukstypene fikk et inntektstap på nærmere 20 000 kr i året ved at de ikke lenger kunne nytte inntil 15 % av fôret som billigere ikke-økologisk fôr.
- Avlingsdata fra systemforsøka ved Planteforsk Apelsvoll forskingssenter (1991–1999) viste størst korn- og potetavlinger ved konvensjonell drift. Avlinger i det

økologiske (integrerte) driftssystemet utgjorde 60–65 (90) % av det konvensjonelle. Avlingsvariasjonen mellom år var størst ved økologisk drift.
- En simuleringsmodell ble anvendt på data fra systemforsøka, supplert med bl.a. priser og arbeidsdata fra andre kilder. Inntektsvariasjonen var størst i det økologiske dyrkingssystemet. Med nåværende tilskottsordninger og økologiske pristillegg svarte det seg likevel best økonomisk med økologisk dyrking, også for brukere med sterk motvilje mot å ta risiko. Dersom tilskott til økologisk drift falt bort, kunne økologisk drift fortsatt være fordelaktig. Dersom både priser og tilskott var som ved konvensjonell drift, ble økologisk drift det klart mest ugunstige valget. Integrert og konvensjonell dyrking kom omtrent likt ut økonomisk.

På bakgrunn av arbeid i dette prosjektet vil vi peke på noen mulige problemstillinger for videre forskning:
- Risikoforskning innen landbruksøkonomien har lagt stort vekt på produksjons- og markedsrisiko. Det store betydningen av politisk (institusjonell) risiko antyder at mer ressurser bør brukes til å forske på politisk risiko. Forskning bør klargjøre begrepet «politisk risiko», hva som kjennetegner og karakteriserer denne type risiko, hvilke forhold som gjør at politikk oppfattes som en stor risikokilde og hvordan politiske spørsmål knyttet til risiko kan kvantifiseres og forutses. Det trengs teoretiske og empiriske studier av hvilke virkninger politisk risiko kan ha på ressursbruk og investeringer i jordbruket. Beskrivende og veiledende studier av hvordan næringsutøvere konkret kan handtere politisk risiko vil være nyttig. Det trengs forskning på hva politikere og forvaltning kan gjøre samt hva de neppe bør gjøre for å avgrense den politiske risiko de utsetter næringsutøvere for.
- Gardbrukerne ble ikke spurt om de ønsket mer kjennskap til og utdanning i risikostyring. Behov for kompetansetiltak innen risiko og risikohandtering i jordbruket kan kartlegges, både hos konvensjonelle og økologiske brukere. Det kan også undersøkes hvilke behov ulike typer gardbrukere og rådgivere har for analyse- og planleggingsverktøy som inkluderer vurderinger av ulike typer risiko, bl.a. ved omlegging til økologisk drift og ved finansiell planlegging av kapitalkrevende bruksutbygginger.
- Den finnes få driftsøkonomiske modeller, som gjør det mulig å analysere strategier for (eventuelt) å legge om til økologisk drift. Stokastiske budsjetteringsmodeller på bruksnivå, hvor de viktigste usikre variable trekkes direkte inn i analysen, kan utvikles.
- Faktisk omfang av pris- og produksjonsrisiko ved økologisk drift kan analyseres dersom det finnes observasjoner fra mange bruk over flere år. Datasett av denne typen kan behandles og analyseres med paneldataøkonometri. De årlige driftsgranskingene til NILF egner seg til dette, men flere økologiske bruk i utvalget er påkrevd før sikre analyser kan utføres.
- Prosjektet viste at registrerte behandlinger ikke er et tilstrekkelig mål på «sanne» antall sjukdomstilfeller i en besetning. Egenbehandling og alternativ veterinær-

medisin blir ikke alltid registrert i sjukdomsstatistikken. Ved sammenliknende studier av sjukdomstilfeller er det behov for kritisk å vurdere registrerte helsedata. Helsedata kan gjøres mer fullstendige med hensyn på «sanne» antall sjukdomstilfeller.

- De økologiske produsentene kan spørres på nytt om noen år for å undersøke om de har endret oppfatninger, målsettinger, driftsopplegg m.v. Da kan man belyse om nykommerne blir mer påvirket av økologiske verdier etter hvert som de får mer erfaring med driftsformen, samt om idealistene kan ha blitt mer pragmatiske og økonomisk orienterte.
- Mer forskning om hvordan en kan få gardbrukere til å legge om til økologisk drift og hva som er de viktigste barrierer for å legge om, vil være gunstig for å få mer innsikt i hva som skal til for å øke omleggingstakten.
- Mer kunnskap trengs om årsaker til at brukere ombestemmer seg og slutter med økologisk drift samt tiltak for å unngå dette.
- Den stokastiske programmeringsmodellen utviklet for økologiske mjølkebruk kan anvendes til å undersøke optimalt driftsopplegg og økonomisk resultat ved en rekke situasjoner, f.eks.: 1) krav om at (alt) fôr skal dyrkes på bruket; 2) krav om at konvensjonell husdyrgjødsel ikke kan tilføres driftsenheten; 3) endringer i priser og tilskottsordninger; 4) endra pris- og avlingsvariasjon; 5) effekter ved bruk av avfallsbasert gjødsel i økologisk drift; og 6) annen endra ressurstilgang. Samfunnsgodeproduksjon ved ulike regelverk og virkemiddelutforminger kan studeres ved å legge miljø- og landskapsindikatorer m.v. inn i modellen.
- Ved å utføre flere simuleringsstudier av plantedyrkingssystem andre steder og med andre vekstkombinasjoner og driftsopplegg, vil en få mer komparativ kunnskap om risiko i dyrkingssystem. Simuleringsmodellen kan utvides ved også å inkludere andre hensyn for gardbruker enn økonomi og inntektsstabilitet (f.eks. miljøvirkninger og dets variasjoner mellom år). Denne type simuleringer vil også være nyttig ved samfunnsmessige vurderinger av alternative dyrkingssystem og deres «bærekraft» i et (mellom)langsiktig perspektiv.

Gjennomgangen viser at prosjektet har bidratt med betydelig og ny innsikt i hvordan økologiske så vel som konvensjonelle gardbrukere oppfatter og handterer risiko, faktisk omfang av risiko ved økologisk drift samt hvordan en kan trekke risiko inn i modeller og beslutningsverktøy til hjelp for gardbrukere. Flere av resultata bør være av særlig nytte for de som arbeider med utforming av politiske rammevilkår for jordbruksnæringa, inkludert for utviklingstiltak innen økologisk jordbruk. Gjennom prosjektet er det avdekket flere områder for videre forskning, og hvor politisk risiko synes å være et særlig interessant og utfordrende område.

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Vedlegg 1

CONFERENCE PAPER

RISK AND RISK MANAGEMENT IN ORGANIC AND CONVENTIONAL DAIRY FARMING: EMPIRICAL RESULTS FROM NORWAY[1]

G. Lien, O. Flaten, M. Ebbesvik, M. Koesling, and P.S. Valle

The objective of this study was to provide empirical insight into dairy farmers' goals, relative risk attitude, sources of risk and risk management responses. The study also examines whether organic dairy farming leads to important risk sources not experienced in conventional farming and, if so, how those extra risks are managed. The data originate from a questionnaire survey of conventional (n=373) and organic (n = 162) dairy farmers in Norway. The results suggest that organic farmers have somewhat different goals than conventional farmers, and that the average organic farmer is less risk averse. Institutional risk was perceived as the most important source of risk, independently of conventional or organic production system. Keeping cash on hand was the most important strategy to manage risk for all dairy farmers.

Key words: risk; risk management; questionnaire survey; dairy farming; organic farming.

Introduction

Farmers' perceptions of and responses to risk are important in understanding their risk behaviour. In the literature much normative analysis (with mathematical programming etc.) has been done to show how farmers should behave under uncertainty (e.g. Hardaker *et al*, 1997). But surprisingly little work is done to examine how farmers perceive risk and risk management in practice.

There is a general belief, apparently not supported by empirical evidence, that organic farming is more risky than conventional farming, partly because it is vulnerable to additional and different sources of risk. Restrictions on pesticide use, fertilisers, synthetic medicines, purchase of feeds etc. are presumed to influence exposure to production risk. Smaller organic markets may mean greater price fluctuations. On the other hand, specific government payments in organic farming result in greater income stability. At the same time, and for both production types, uncertainty of future government payments (institutional risk) may be of concern to farmers. The perception of higher risk may be a potential barrier for switching to organic farming (Lampkin, 1994).

Surveys have been conducted asking about the types of risk perceived as most important by conventional farmers and about the management strategies the farmers use. Harwood *et al* (1999) has summarised US studies. US farmers, included dairy farmers, are most concerned about commodity price risk, production risk, and changes in government laws and regulations. Arizona dairy producers perceived the costs of operating inputs to be the greatest source of risk (Wilson *et al*, 1988). A 1996 USDA

1. This paper was presented at the 14th International Farm Management Congress, August 11-15, 2003, Perth, Australia. And is reprinted by kind peremission of the organisers.

survey found that keeping cash on hand was the number one risk management strategy for every farm size, for every commodity speciality, and in every region studied. Use of derivative and insurance markets was also considered important. Huirne *et al* (2000) and Meuwissen *et al* (2001) found that Dutch livestock farmers considered price and production risks to be most important. Producing at lowest possible costs and insurance were the most important risk management strategies for these farmers.

In Norway, no comparable studies have been conducted among conventional or organic farmers. No such studies have been found in other countries either.

This relative lack of information about farmers' risky environment and their reactions to it means that there are few useful practical insights for policy makers and farm advisers. The objective of this paper is thus to provide empirical insight into: 1) Norwegian dairy farmers goals', risk perceptions and risk management responses; and 2) differences in risk perceptions and risk management responses between conventional and organic dairy farmers.

Materials and methods

Data originate from samples of Norwegian dairy farmers and have been gathered by a questionnaire survey. The questionnaire consisted of questions related to: 1) farmers' perceptions of risk (including questions on sources of risk and risk attitude); 2) farmers' perceptions of various risk management strategies; 3) farmers' goals, future plans and motivations for their farming system (organic or conventional); 4) animal disease management strategies; and 5) socio-economic characteristics of the farmers. Most questions were closed questions, many in the form of Likert-scales.

The Norwegian Agricultural Authority has a register of farmers who receive support payments (i.e. all farmers), including each farmer's stocking and cropping details. This data set was merged with the questionnaire survey.

The questionnaire was first sent out in January 2003 to 616 randomly selected conventional dairy farmers and all 245 registered organic dairy farmers. Conventional farmers were selected from the register of farmers who received support payments based on their 2001 application. Six conventional and one organic farmer informed us that they had quit farming. 373 conventional and 162 organic farmers returned the questionnaire. The effective response rates for conventional and organic farmers are 61.1% and 66.4%, respectively. In Table 1 average data from respondent farms in the survey is compared with average Norwegian farms.

On average farms in the survey are slightly larger than the average Norwegian dairy farm. Organic dairy farmers have more farmland and use the most farmland for producing forage. But they have (on average) only a few more cows than a conventional average farm. Labour input is similar on conventional and organic farms. Organic farmers have generally more years of schooling that conventional farmers and more of them have some

Table 1. Comparison of dairy farms in survey with average dairy farms in Norway.

Characterisics	Conventional		Organic	
	Average farm in Survey (n=373)	Average farm in Norway	Average farm in Survey (n=162)	Average farm in Norway
Number of dairy cows	16.0	14.7	16.4	15.9
Farmland (ha)	24.5	22.1	29.4	28.1
Labour units (man-year)	2.1	-	2.1	-
Education (%) [1]	17/70/10/3	-	6/55/22/17	-
Agricultural education (%)	59	-	77	-

1. Primary school/high school/BSc/MSc.

agricultural education. Most of the farms surveyed are family farms: 93% of conventional and 91% of organic farms. Joint operations occur on 6% of the dairy farms.

In this paper simple descriptive statistical analyses are used to answer the research questions.

RESULTS

Dairy farmers' goals

The questionnaire contained a list of 14 often-expressed goals among farmers. Farmers were asked to select the five most important goals. Table 2 shows per cent of responses recorded for each goal.

Table 2. Dairy farmers goals. Percentage of responses ranking each goal among the top five goals (Rank in parenthesis).

Farmers goal	Conventional	Organic
Certain and stable income	78.0 (1)	56.2 (3)
Produce high quality food	76.4 (2)	77.8 (2)
Independence	49.9 (3)	43.2 (5)
Time for family living, concerns for children	49.6 (4)	53.1 (4)
Improve the farm for next generation	44.2 (5)	32.7 (7)
Have possibility to some leisure	36.5 (6)	22.8 (8)
Sustainable and environment-friendly farming	36.5 (6)	80.2 (1)
Reduce debt, become free of debt.	30.8 (8)	21.6 (9)
Continue to be a farmer	25.5 (9)	21.0 (10)
Maximise profit	24.7 (10)	12.3 (11)
Work with animals/crops	22.5 (11)	35.2 (6)
Social contacts	5.6 (12)	8.0 (12)
Increase equity	3.5 (13)	2.5 (13)
Higher private consumption	2.4 (14)	0.0 (14)

Most organic farmers rank sustainable and environmentally friendly farming among their top five goals. The conventional farmers' ranking for this goal is much lower. Instead, they give highest priority to income stability on average. Producing high quality food is ranked second by both groups. Independence and time for family living are other relatively highly ranked goals. As often found in studies of farmer' goals, profit maximisation is ranked rather low – and lowest among organic farmers. These results support earlier studies (e.g. Gasson *et al*, 1988; Willock *et al*, 1999) reporting that farmers have several goals – not only one.

Perceptions of relative risk attitude

Farmers were asked to assess their willingness to take risk, relative to others, on Likert-type scales ranging from 1 (do not agree) to 7 (fully agree). Since statements measure attitude toward risks relative to others we use the term relative risk attitude (Patrick and Musser, 1997; Meuwissen *et al*, 2001). Figure 1 shows the percentage distribution of the respondents' answers, for conventional and organic dairy farmers, respectively, in relationship to following statements "I am willing to take more risk than other with respect to: 1) production; 2) marketing; and 3) finance and investment", respectively.

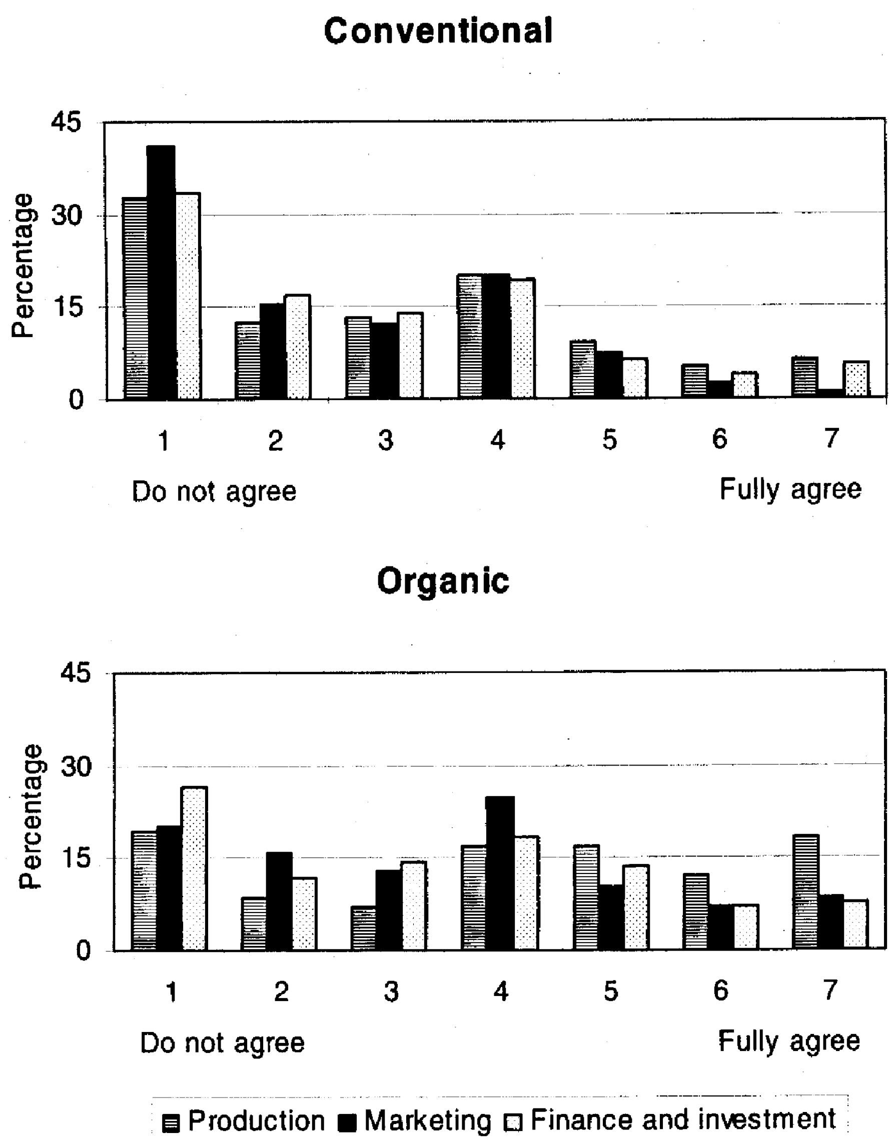
Most conventional dairy farmers perceive the extent to which they take risks as less than that of others. By contrast, the figure shows that the responses of the organic dairy farmers have a more symmetric distribution over the scale of relative risk attitudes, especially with respect to production risks. These results suggest that the average organic farmer is less risk averse than his/her conventional colleagues. Organic farmers have been few in numbers and the amount of experience with this form of production is somewhat restricted. Some willingness to take risk should therefore be expected among those adopting organic farming practices. Gardebroek (2002) also found, from historical data, that organic farmers are less risk averse then their non-organic colleagues.

Perceptions of sources of risk

A total of 33 sources of risk were presented to respondents in the survey. Farmers were asked to score each source of risk on a Likert-scale from 1 (no impact) to 7 (high impact) to express how significant they considered each source of risk to be in terms of its potential impact on the economic performance of their farm. Farmers were then asked to select and rank the three most important sources of risk (i.e. the three sources of risk they feared most). Table 3 shows average scores for important sources of risk and their frequency in farmers' top three sources of risk.

Uncertainty about the continuation of general government support payments to farmers stands out as the top-rated source of risk for all dairy farms. Not surprisingly, organic farmers also gave high priority to uncertainty regarding specific government support payments for organic farming. Policy instruments like import barriers, public payments, market regulation, and supply control (milk quotas) have raised and stabilised

Figure 1. Percentage distribution of respondents relative risk attitudes over categories. Farmers assessment of their willingness to take risk on a scale from 1 (do not agree) to 7 (fully agree)



farm-gate prices. Target prices and support schemes are decided through annual negotiations between the two farmers' unions and the Government. Many respondents added uncertainties caused by WTO and Norway's EU-relationship. The high average rankings the farmers gave to uncertainty about milk and meat prices is therefore presumably related to farmers' fears of farm policy deregulation. Some other institutional risks are also highly ranked (tax policy, animal welfare policy, milk quota policy, and organic farming regulations). Anxiety about possible changes to animal

Table 3. Dairy farmers' perceptions of important sources of risk. (Rank in parentheses)

Source of risk	Conventional		Organic	
	Average score	% in top three	Average score	% in top three
Government support payments [1]	5.91 (1)	40.2 (1)	5.54 (1)	37.0 (1)
Tax policy	5.86 (2)	16.6 (6)	4.96 (6)	9.3 (11)
Milk price	5.77 (3)	20.6 (4)	5.26 (2)	21.0 (3)
Meat prices	5.54 (4)	7.8 (10)	4.68 (10)	4.3 (20)
Milk quota policy	5.52 (5)	15.6 (7)	4.79 (90	8.0 (13)
Animal welfare policy	5.38 (6)	33.8 (2)	4.15 (17)	19.1 (5)
Input costs (capital items excluded)	5.22 (7)	6.2 (12)	3.96 (21)	1.9 (24)
Injury illness or death of operators	5.19 (8)	13.7 (9)	5.02 (5)	24.7 (2)
Consumer preferences	5.17 (9)	17.4 (5)	5.09 (4)	12.4 (7)
Non-domestic (exotic) animal diseases	5.10 (10)	26.0 (3)	4.49 (13)	21.0 (3)
Domestic epidemic animal diseases	4.96 (11)	14.2 (8)	4.11 (18)	8.6 (12)
Forage yields	4.85 (12)	5.4 (13)	4.38 (8)	10.5 (6)
Additional government payments to organic farming	-	-	5.24 (3)	14.8 (6)
Price premium organic products	-	-	4.96 (7)	9.9 (10)
Organic farming regulations	-	-	4.61 (12)	11.7 (8)

1. Specific organic farming payments excluded

welfare policy is less pronounced among organic farmers, presumably because of already strict organic farming standards. This source of risk ranks substantially higher in top three than as an average score, indicating large variations (and may be some inconsistency), in farmers' perceptions of this source of risk.

Dairy farmers ranked operator's health, epidemic animal diseases and consumer preferences as other important sources of risk. Organic farmers assigned somewhat less importance to epidemic animal diseases than conventional producers.

Organic farmers indicated greater concern with forage yields as a source of risk. Conventional farmers found costs of operating inputs more important. The finding that organic farmers rank forage yields risk higher than do conventional farmers is probably a result of different management approaches in the two farming systems. The same consideration applies to input costs, since organic farmers generally have a production system with low levels of purchased inputs. These results support the proposition that the organic production systems have somewhat different sources of risk than those faced by conventional farmers.

Factors that scored low (and consequently were not listed in Table 3) include land rent and land availability, family relations, milk yield, credit availability, non-epidemic animal diseases and uncertainty concerning hired labour.

A common classification of risk is into production, price, institutional, personal and financial risk (Hardaker *et al*, 1997). Within this broad classification, institutional risks dominate in the results from this survey (government support payments, taxes, animal welfare regulations, milk quota policy etc.), while production and price risk was perceived as the next most important sources of risk. That institutional risk is perceived as most important may be explained by the fact that the Norwegian government has regulated and assigned large public payments to agriculture at the same time as national and international policies are changing frequently and unpredictably. Since farming is typically a risky business, governments around the world have intervened to varying degrees to try to help farmers cope more effectively with risk. In this context it is a paradox that farmers perceive institutional risk as the most important source of risk. What can farmers do at farm level to cope with this type of risk?

Risk management strategies among dairy farmers

Some 25 risk management strategies were presented for the farmers. Farmers indicated the importance of each strategy for them on a Likert-scale from 1 (not relevant) to 7 (very relevant). Next, they were asked to identify and rank the three most important strategies they planned to use in the future. Results are summarised in Table 4.

The results show that there are many risk management strategies that farmers see as important and useful. The degree of importance assigned to the different strategies varies considerably among farmers.

*Table 4. Dairy farmers' perceptions of important risk management strategies. (**Rank in paretheses.**)*

Risk management strategy	Conventional		Organic	
	Average score	% in top three	Average score	% in top three
Liquidity keep cash in hand	6.49 (1)	41.6 (1)	6.18 (1)	31.5 (2)
Prevent and reduce livestock diseases	6.35 (2)	26.0 (3)	6.16 (2)	24.7 (3)
Buying business insurance	6.13 (3)	13.9 (8)	5.79 (3)	14.2 (7)
Producing at lowest possible costs	5.94 (4)	31.9 (2)	5.61 (5)	35.2 (1)
Buying personal insurance	5.93 (5)	8.6 (12)	5.50 (6)	6.8 (15)
Risk-reducing technologies	5.69 (6)	4.8 (15)	5.69 (4)	9.9 (11)
Solvency debt management	5.64 (7)	23.1 (4)	5.15 (9)	17.9 (4)
Prevent and reduce crop diseases and pests	5.53 (8)	4.8 (15)	5.40 (7)	5.6 (17)
Use of agronomic and nutrition consultants	5.43 (9)	5.9 (14)	5.03 (10)	6.2 (16)
Small, gradual changes	5.39 (10)	15.6 (6)	5.23 (8)	12.4 (10)
Cooperative marketing	5.36 (11)	14.5 (7)	4.83 (12)	13.0 (9)
Shared ownership of equipment, joint operations	4.84 (14)	15.8 (5)	4.64 (14)	15.4 (5)
Cost flexibility	4.61 (15)	12.3 (9)	4.66 (13)	7.4 (14)
Enterprise diversification	4.28 (17)	7.2 (13)	4.44 (15)	14.8 (7)
Off-farm work	4.07 (20)	12.3 (9)	4.01 (22)	15.4 (5)

Generally, the most preferred strategies to manage risk are strategies to cope with institutional risks. Good liquidity was selected in the top three by 42% of the conventional farmers, and by a somewhat smaller proportion of organic farmers. Solvency was also ranked relatively high. Producing at lowest possible cost was considered as the most important strategy to manage risk by organic farmers.

To prevent and/or reduce livestock diseases was ranked as one of the most important risk management strategies. This strategy reduces the exposure to risk through monitoring and control, and is an important management strategy to deal with downside risk.

Purchasing some kind of business and personal insurance was ranked relatively highly. Insurance, together with cooperative marketing are somewhat different in nature from the other listed strategies in Table 4. They belong to a risk management category often named risk-sharing strategies, while the others are on-farm strategies (Hardaker *et al*, 1997).

Organic dairy farmers regard asset flexibility, product flexibility and market flexibility, enterprise diversification and use of risk-reducing technologies as more important risk strategies than their conventional colleagues. Collecting information has a low score, particularly among conventional farmers. This finding should be seen in the light of the massive system for data recording (especially production and health information) that has long existed for Norwegian dairy herds, together with new data reporting systems (quality assurance systems) coming up. The low ranking could therefore be more of a negative response to the need to collect still more information than to the importance of collecting as at present.

Farmers generally did not see corporate farm organisation, off-farm investments, having idle production/machinery capacity, and the use of price contracts as important strategies (i.e., very few had selected these strategies in the top three and they had a low score on the Likert-scale). That use of price contracts has been assigned a low score may be because of the extensive use of cooperative marketing among Norwegian farmers.

The current Norwegian agricultural policy system is no doubt also a factor that reduces the perceived need for price contracts.

Conclusions

To get empirical insight into dairy farmers' perceptions of risk exposure and risk management strategies, and differences between organic and conventional farmers, a questionnaire survey was undertaken. Because of the sampling strategy used and the high response rate, the results are believed to be representative for conventional and organic dairy farmers in Norway.

The results confirm previous findings that farmers have several goals. Organic dairy farmers rank sustainability and environmental farming highest, while conventional farmers rank stable income as the most important goal. Our results suggest that organic dairy farmers are less risk averse than their non-organic colleagues.

The most important source of risk, regardless of production system, is payments. Organic dairy farmers are more concerned about forage yields risk, while input cost is regarded as a more important source of risk among conventional than organic farmers .

The survey shows that there are many risk management strategies that dairy farmers see as important and useful. Generally, the strategies to manage risk that were ranked as most important were on-farm strategies to cope with the institutional risk. But risk-sharing strategies, such as purchasing business and personal insurance were also ranked highly. Organic dairy farmers regarded flexibility and diversification as more important risk management strategies than the conventional ones.

In what type of farming contexts are our findings relevant? That support payments and regulation levels are high in Norway has obvious impacts on our results. Nevertheless, the agricultural policy system is not very different from what is found, e.g., in the EU countries. This implies that some similar results could be found in many other countries too.

Clear differences were revealed by the survey in how organic and conventional farmers perceive sources of risk and how they manage risk. Therefore policy makers, advisers and researchers should take these differences into account.

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Biographical notes

Gudbrand Lien (corresponding author, e-mail: gudbrand.lien@nilf.no) and Ola Flaten are senior researchers at the Norwegian Agricultural Economics Research Institute.

Martha Ebbesvik is senior adviser and Matthias Koesling is researcher at the Norwegian Centre for Ecological Agriculture.

Paul Steinar Valle is Chair of the Institute of Livestock Medicine, The Norwegian School of Veterinary Science.

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Risk and Risk Management in Organic and Conventional Cash Crop Farming in Norway

Koesling, M., Ebbesvik, M., Lien, G., Flaten, O., Valle, P. S. and Arntzen, H. (Norwegian Centre for Ecological Agriculture, Tingvoll; Norwegian Agricultural Economics Research Institute, Oslo; Eastern Norway Research Institute, Lillehammer; Norwegian School of Veterinary Science, Oslo; and Department of Informatics, Molde University College, Molde, Norway). Risk and risk management in organic and conventional cash crop farming in Norway. Acta Agric. Scand., Sect. C, Food Economics 1: 195–206, 2004. © 2004 Taylor & Francis.

This study presents empirical insight into organic and conventional cash crop farmers' perceptions of risk and risk management strategies, and identifies socio-economic variables linked to these perceptions. The data originate from a questionnaire survey of farmers in Norway. The results indicate that organic farmers perceived themselves to be less risk averse than conventional farmers. For both groups, crop prices and yield variability were the two top rated sources of risk, followed by institutional risks. The two groups evaluated risk management strategies quite similarly; favoured strategies were good liquidity and to prevent and reduce crop diseases and pests. The farmers' evaluation of sources of risk and choice of risk strategies depended on various socio-economic variables. The importance of institutional risks implies that policy makers should be cautious about changing policy capriciously and they should consider strategic policy initiatives that give farmers more long-term reliability.

Matthias Koesling[1]*, Martha Ebbesvik[1], Gudbrand Lien[2,3], Ola Flaten[2], Paul Steinar Valle[4] and Halvard Arntzen[5]

[1]Norwegian Centre for Ecological Agriculture, Tingvoll, Norway, [2]Norwegian Agricultural Economics Research Institute, Oslo, Norway, [3]Eastern Norway Research Institute, Lillehammer, Norway, [4]Norwegian School of Veterinary Science, Oslo, Norway, and [5]Department of Informatics, Molde University College, Molde, Norway

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1. Introduction

Farmers' perceptions of and responses to risk are important in understanding their risk behaviour. In the literature, extensive normative analysis (with mathematical programming etc.) can be found, showing how farmers should behave under uncertainty (e.g. Hardaker et al., 2004). But surprisingly few studies have examined how farmers perceive risk and manage it in practice.

Organic farmers are exposed to additional and different sources of risk compared to conventional farmers. Restrictions on pesticide use, fertilizers etc. influence production risk (Padel & Lampkin, 1994a). Smaller organic markets may mean greater price fluctuations. On the other hand, specific direct payments in organic farming result in greater income stability (Offermann & Nieberg, 2000). Some studies suggest that increased enterprise diversity on organic farms reduces risk, but often at the cost of lower expected returns (Hanson et al., 1990).

A few surveys have been conducted about the types of risk perceived as most important by conventional farmers and about the management strategies used by farmers. US cash crop farmers were most concerned about commodity price risk, production risk, and

*Corresponding author. E-mail: matthias.koesling@norsok.no

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changes in government laws and regulations (Harwood et al., 1999). Patrick and Musser (1997) analysed sources of and responses to risk among large-scale US cornbelt farmers. Costs and human aspects were perceived as the most important sources of risk. Liability insurance, financial and credit reserves, and debt management were identified as important risk responses. Martin (1996) identified important risk management strategies used by farmers and horticulturists in New Zealand. Price and weather risk were ranked as the most important risk sources among cash crop farmers. Routine spraying, enterprise diversification and keeping debt low were the chief management responses. Dutch livestock farmers considered price and production risks to be most important (Meuwissen et al., 2001). Producing at lowest possible costs and insurance were the most important risk management strategies.

As far as we know, no earlier studies have compared conventional and organic cash crop farmers' risk perceptions and risk management strategies. In the Nordic countries, no studies at all have explicitly investigated cash crop farmers' risk perceptions and the ways they deal with the risks.

This relative lack of information about (especially organic) farmers' risky environment and their reactions to it means that there are few useful practical guidelines for policy makers, farm advisers and researchers. The objectives of this exploratory study were, to provide empirical insight into: (i) Norwegian cash crop farmers' goals; (ii) their perceptions of risk and risk management responses; (iii) differences in risk perceptions and management responses between conventional and organic cash crop farmers; and (iv) farm and farmer characteristics related to these perceptions and strategies.

2. Data collection

The data were collected in a questionnaire survey of risk and risk management in Norwegian farming. Respondents were selected among Norwegian cash crop and dairy farmers. This article examines data from cash crop farms, including both specialized cash crop farms and mixed crop-livestock farms. Specialized cash crop farms were defined as having at least 1 ha grain, 0.5 ha potatoes, or 0.2 ha vegetables, fruits, or berries. Mixed crop-livestock farms should have at least 2.5 ha grain, 0.5 ha potatoes or 0.5 ha vegetables, fruits, or berries. Farms with dairy cows were excluded. The data from these farms are examined in Flaten et al. (2004).

The questionnaire consisted of questions related to: (i) farm and farmer characteristics; (ii) the farmers' goals, future plans and motivations for choice of farming system, organic or conventional; (iii) the farmers' perceptions of risk, including risk attitude and sources of risk; and (iv) the farmers' perceptions of various risk management strategies. Most questions were of the closed type, many in the form of seven-point Likert scales (Pannell & Pannell, 1999). The questionnaire was pre-tested both internally and in a few sessions with farmers, and refined over several stages based on the comments and suggestions received.

As a simple measure of farmers relative risk attitude[1] (Patrick & Musser, 1997; Meuwissen et al., 2001), the respondents were asked to what degree they perceived themselves to be more willing than others to take risk related to *production, marketing* and *finance and investment*. The answers to these three issues were on a scale from 1–7, 1 indicating much less willing than others, and 7 indicating much more willing than others.

From a list of 14 farming goals, the respondents were asked to select up to five goals as most important for them and to rank the importance of their selected goals.

A total of 30 sources of risk and 25 risk management strategies relevant for cash crop farmers were presented to the respondents. Farmers were asked to score each source of risk on a Likert-scale from 1 (no impact) to 7 (very high impact) to express how significant they considered each source of risk to be in terms of its potential impact on the economic performance of their farm. Farmers indicated their perceived importance of each strategy on a Likert-scale from 1 (not relevant) to 7 (very relevant).

The Norwegian Agricultural Authority (SLF) has a register of farmers who receive support payments (i.e. all farmers in Norway), including each farm's stocking and cropping details. This data set (2002-data) was merged with the questionnaire survey data.

The questionnaire was first sent out in January 2003 to the 611 randomly selected conventional cash crop farmers and all 212 registered cash crop farmers with some organic farmland. Farms with both conventional and organic production were classified as organic if more than 25% of the farmland was organic or in conversion to organic in accordance with national standards and laws for organic agriculture (Debio, 1998). Otherwise, they were classified as conventional farms.

We were informed that 27 farmers of the ones that had received a questionnaire had quit farming. After a month, a reminder letter was posted, and in March a

[1] More advanced methods to measure farmers' risk attitude are discussed in Hardaker et al. (2004) and Moschini and Hennessy (2000).

new copy of the questionnaire was sent to farmers who had not yet responded. In total, 488 cash crop farmers (61%) returned a completed questionnaire. Not every respondent answered all questions.

3. Methods

The responses on farming goals were reorganized by labelling a goal as *important* if it was selected and rated among the three most important by the farmer. Otherwise the goal was labelled *less important*. To compare organic and conventional farmers' ratings of various farming goals as important or less important, chi-square tests were used.

Scores from the risk attitude questions were compared by t-tests. A simple factor analysis applied to variables measuring relative risk attitude resulted in one factor, indicating that the three risk willingness items to some degree measure the same underlying dimension. Hence we decided to generate a standardized risk index for each farmer by adding and standardizing the ratings. This risk index was used in regression analysis as a measure of the individual risk attitude.

Farmers' perceptions of risk and risk management were initially examined by descriptive analyses. Mean values obtained in conventional and organic farming were compared by t-tests. Standard parametric statistical procedures were assumed appropriate for ordinal variables in the form of Likert-type scales (e.g. Patrick & Musser, 1997; Meuwissen et al., 2001).

Principal component factor analysis (PCA) was used to summarize the information in a reduced number of factors and to generate factors that were as independent as possible for subsequent use in regressions. The latent root criterion (eigenvalue ≥ 1) was first used as a guideline to determine how many factors to extract. In order to have the most representative and parsimonious set of factors, factor solutions with different numbers of factors were also examined before the structures were defined (Hair et al., 1998). Orthogonal (varimax) rotation was used to obtain factor solutions that were easier to interpret. Standardized factor scores for each farmer and factor were saved for subsequent multiple regressions.

Some 15–25% of the respondents did not answer one or more questions about sources of risk and risk management strategies. In such cases, the respondent was excluded if more than 33% of the variables for risk source or risk management strategies were missing. Less than 7% of the cases were excluded by this procedure. When only few questions had been left open, these data points were replaced with the mean value of that variable based on all valid responses.

Because preliminary PCA analyses revealed very similar factor structures among risk sources and risk management strategies for conventional and organic farmers, joint factor analyses including both types of farmers were carried out.

Multiple least squares regressions were used to study associations between farm and farmer characteristics, risk perceptions and risk management. We assumed a functional relationship between behaviour and manager characteristics and perceptions to exist (Van Raaij, 1981). We used this model of a firm's decision-making environment to specify the regressions. Simple correlation coefficients between all pairs of independent variables were low. Variance inflation factors were close to 1 and condition indices were low, indicating no multicollinearity problems (Belsley et al., 1980). Results obtained by the full model fitted (complete model), backward elimination, and the stepwise method were compared. The three approaches gave very similar estimates. We decided to work with the models obtained by the stepwise procedure. The criteria used for inclusion and exclusion were set to $P < 0.10$ and $P > 0.15$, respectively.

All statistical analyses were conducted using SPSS (v 11.5.1) for Windows.

4. Results and discussion

4.1. Key characteristics of respondents and farms

Most of the farmland on conventional farms was used to produce grain and oil seeds (Table 1). Organic farmers had less farmland but more animals than the conventional farmers. Organic farms used more than one third of the farmland to produce forage, which is necessary to achieve a high share of farm-grown fodder. Organic farmers had more education, and more of them had specific agricultural training. Most respondents were organized as family farms: 97% of the conventional and 93% of the organic farms. Joint operations occurred more frequently on organic farms (3.7%) than on conventional farms (1.6%). Nearly 4% of the organic farms were schools, institutions, other forms of co-operation or were leased, whereas less than 1% of the conventional cash crop farms belonged to these categories.

4.2. Important goals for farmers

Table 2 shows the percentage of conventional and organic farmers rating various farm goals as important, and whether the ratings by conventional and organic farmers differed significantly.

As listed in Table 2, conventional farmers ranked the goal *reliable and stable income* first, *producing high*

Table 1. Comparison of cash crop farms in survey with average cash crop farms in Norway

	Conventional		Organic	
	Average farm in the survey	Average farm in Norway[1]	Average farm in the survey	Average farm in Norway[1]
Number of farms	379	15,459	109	202
Farms with livestock production[2] (% of all farms in the group)	22.4	20.2	56.0	51.0
Farmland (ha)	23.4	20.9	20.8	22.9
Grain and oil seeds (% farmland)	86.3	84.1	47.4	57.6
Meadow (% farmland)	7.6	9.3	41.3	34.5
Potato (% farmland)	3.2	3.8	1.5	2.4
Vegetables and fruits (% of farmland)	2.6	2.4	2.2	2.4
Labour units (man-year)	1.0	–	1.1	–
Age of farmer (years)	50	55	50	56
Highest level of education[3] (%)	12/50/20/14	–	11/39/29/21	–
Agricultural education (%)	52	–	69	–

[1]Data 2002 from the Norwegian Agricultural Authority. [2]Includes farms with production of beef cattle, horses, poultry, pigs, sheep, goats, chickens, or laying hens. [3]Primary school/secondary school/BSc/MSc.

quality food second, and *prosperity, living quality for children, time for family* third on average. The highest ranked goal for organic farmers was *sustainable and environment-friendly farming*, rated as important by 54%. Ranked second was *producing high quality food* and third *reliable and stable income*. As often found in studies of farmers' goals, profit maximization ranked rather low (e.g. Gasson et al., 1988; Willock et al., 1999; Bergevoet et al., 2004), and lower among organic farmers. Our results support earlier studies that farmers choose to convert to organic farming for a number of reasons in addition to financial ones (e.g. Padel & Lampkin, 1994a).

4.3. Perceptions of relative risk attitude

Organic farmers on average felt that they were more willing to take risk relative to others than did conventional farmers (Table 3). With particular respect to production and marketing, organic farmers tended

Table 2. Cash crop farmers' goals (ranked by declining importance for conventional farmers)

	Conventional[1]	Organic[1,2]	
Goals	%	Rank	%
Reliable and stable income	42.5	3	30.3*
Producing high quality food	40.4	2	48.6
Prosperity, living quality for children, time for family	29.0	5	17.4*
Improve the farm for the next generation	25.1	6	15.6*
Sustainable and environment-friendly farming	23.7	1	54.1***
Independent work, self employment	21.4	4	28.4
Maximize profit	19.5	8	10.1*
Reduce debt, become free from debt	12.4	9	6.4
Continue to be a farmer	11.6	11	3.7*
Work with animals/crops	9.0	7	14.7
Have sufficient leisure time	2.6	10	5.5
Increase equity	1.6	14	0.0
Social contacts	1.1	12	1.8
Higher private consumption	0.8	13	0.0

[1]Percentage of farmers ranking the goal as one of the three most important goals. [2]Mean numbers marked with asterisks show that the percentages of conventional ($n = 379$) and organic ($n = 109$) farmers rating the goals as important are significantly different at $^{*}P < 0.05$, $^{**}P < 0.01$ and $^{***}P < 0.001$, based on the chi-square test.

Table 3. Farmers' perceived willingness to take risk relative to others

	Conventional[1] Mean	Organic[1,2] Mean
Production	3.11	4.44***
Marketing	2.98	3.97***
Finance and investment	2.87	3.43**
Average	2.99	3.95

[1]Farmers' assessment of their willingness to take risk on a scale from 1 (do not agree) to 7 (fully agree). The statements were "I am willing to take more risk than others with respect to: (1) production; (2) marketing; and (3) finance and investment", respectively. [2]Mean numbers marked with asterisks show that the mean scores of conventional and organic farmers are significantly different at $*P<0.05$, $**P<0.01$ and $***P<0.001$, based on independent samples t-test.

to rate their risk-taking willingness as higher than conventional farmers.

So far, there are few organic farmers and the experience with this form of production is limited. A cropping system trial in Norway showed that the average grain yields of barley in organic cash crop systems were 66% of the conventional barley yields (Kerner, 1994; Eltun & Nordheim, 1999), and there is evidence for greater variability in crop yields and prices with organic than with conventional farming (Padel & Lampkin, 1994b). Some willingness to take risk should therefore be expected among those adopting organic farming practices. Gardebroek (2002) found organic farmers to be less risk averse than their conventional colleagues.

4.4. Perceptions of risk sources

Crop price variability and *crop yield variability* stand out as the two top-rated sources of risk in both groups (Table 4). Price and production risks were also ranked very highly in previous surveys of crop farmers (Boggess et al., 1985; Martin, 1996; Patrick & Musser, 1997). Other highly ranked risks in this study were *changes in government support payments* and *changes in consumer preferences*. Moreover, some other institutional risks, especially tax policy, had high ratings. For dairy farmers in Norway, both conventional and organic, uncertainty about the continuation of general government support payments and milk price variability stood out as the top-rated sources of risk, while milk yield variability scored low (Flaten et al., 2004).

In Norway, target prices and support schemes are determined in annual negotiations between the two farmers' unions and the government. Domestic farm-gate prices are usually much higher than world market prices. High average rankings related to crop prices may thus be related to farm policy. The high scores for the importance of institutional risks may be related to somewhat unpredictable and frequent changes of Norwegian farm policies and regulations, together with external pressures for deregulation and fears of farm support cuts. Institutional risks are not only restricted to Norway. Risk connected to changes in the subsidy system and the abandonment of price supports for farmers is important both in the United States and the European Union (Klair et al., 1998).

Organic cash crop farmers ranked three specific organic off-farm sources of risk (*additional organic farming payments*, *price premiums on organic products*, and *organic farming laws and regulations*) significantly higher than conventional farmers. High scores for external organic risk sources may reduce the growth in the area of cropland under organic management. Organic farmers' higher ranking of *marketing and sale* may reflect the higher instability in organic product markets. Having in mind that 56% of the organic respondents had a mixed crop-livestock operation, in contrast to 22% for the conventional ones, it is not surprising that many sources of risk related to livestock and forage production had much more importance for organic farmers.

Organic farmers particularly attached less importance to such sources of risk as *costs of operating inputs*, *costs of capital equipment*, and *crop price variability*. The finding that organic farmers ranked input cost risk lower than conventional farmers is probably due to the use of production systems in organic farming with low levels of purchased inputs. Sources of risk that scored low for both groups included *hired labour, family relationships*, *credit availability*, and *leasing farm land*.

Of the 30 presented sources of risk, 22 were related to cash crop farming. A factor analysis on these 22 sources, using principal component extraction combined with a varimax rotation, resulted in 6 factors with an eigenvalue greater than 1. The Kaiser-Meyer-Olkin measure for the entire set of variables was 0.815, suggesting the matrix was suitable for factor analysis. The Measure of Sampling Adequacy (MSA) and the communalities for each variable were satisfactory. The six-factor solution gave the most interpretable factors and was judged to be most useful. These factors explained 64.4% of the total variation, a satisfactory amount in social sciences (Hair et al., 1998). Table 4 displays the six factors and their respective loading items, excluding those for which the absolute value of the loadings was less than 0.30.

The factors 1 to 6 were labelled *institutional*, *external organic*, *human resources*, *credit*, *crop*, and *market*, respectively. Factor 1, named *institutional*, had

Table 4. Mean score for conventional and organic farmers, and varimax rotated factor loadings for sources of risk (ranked by declining importance for conventional farmers)

	Conventional	Organic		Factors[3]					
Sources of risk	Mean[1]	Rank	Mean[1,2]	1	2	3	4	5	6
Crop price variability	5.94	1	5.42***					0.83	
Crop yield variability	5.60	2	5.39					0.85	
Changes in tax policy	5.51	8	5.06**	0.76					
Changes in gov. support payments	5.45	4	5.30	0.70					
Costs of operating inputs	4.96	23	3.45***	0.66			0.34		
Changes in consumer preferences	4.94	5	5.23						0.83
Marketing/sale	4.85	6	5.18*						0.80
Injury, illness, death of operator(s)	4.55	11	4.63			0.72			
Other gov. laws and regulations	4.51	15	4.23	0.64					
Costs of capital equipment	4.51	19	3.90***	0.58			0.45		
Technical failure	4.24	16	4.03	0.34		0.42		0.39	
Fire damages	3.93	20	3.87			0.66			
Changes in technology	3.86	22	3.65	0.35			0.49		
Meat price variability[4]	3.80	9	4.81**						
Cost of credit (interest rate)	3.76	18	3.98				0.78		
Family members' health situation	3.75	17	4.02			0.78			
Forage yield uncertainty[4]	3.63	12	4.59***						
Meat production variability[4]	3.43	21	3.80**						
Leasing farm land	3.31	30	2.73**	0.30			0.49		
Non-domestic epidem. animal dis.[4]	3.27	13	4.44***						
Domestic epidemic animal diseases[4]	3.18	14	4.27***						
Credit availability	3.14	26	3.22				0.79		
Animal production diseases[4]	3.11	24	3.39						
Add. organic farming payments	3.07	3	5.38***		0.89				
Animal welfare policy[4]	3.02	28	3.04						
Uncertainty about family relations	2.99	25	3.33			0.67	0.32		
Legislation in animal prod. hygiene[4]	2.86	29	2.99						
Organic farming laws and regulations	2.78	10	4.70***		0.92				
Hired labour	2.75	27	3.07				0.46	0.38	
Price premiums organic products	2.67	7	5.10***		0.91				
% of total variation accounted for				13.0	12.3	12.0	11.1	8.5	7.6

[1]Mean score (1 = no impact, 7 = very high impact) for conventional and organic farmers. [2]Mean numbers marked with asterisks show that the mean scores of conventional and organic farmers are significantly different at $*P < 0.05$, $**P < 0.01$ and $***P < 0.001$, based on independent samples *t*-tests. [3]Factors 1 to 6 for sources of risk are *institutional, external organic, human resources, credit, crop,* and *market*, respectively. Factor loadings $< |0.30|$ are not shown. [4]The variable is related to livestock production and not included in the factor analysis.

high loadings from public payment and government variables, and input prices. The three specific external risks for organic farming loaded extremely on factor 2, labelled *external organic*. Factor 3, *human resources*, includes both health risk of the operator and the family, uncertainty about the family, technical failure, and fire. Factor 4 has high loadings from credit costs and availability and was called *credit*. Crop prices and crop yield variability loaded strongly on factor 5, labelled *crop*. Factor 6, *market*, involves significant loadings of changes in consumer preferences, marketing and sale.

4.5. Perceptions of risk management strategies

Organic and conventional farmers rated management strategies more similarly than they rated the sources of risk (Table 5). For both groups of cash crop farmers, good *liquidity* was the top rated strategy. The 1996 USDA Agricultural Resource Management Survey also found that *keeping cash on hand* was the number one strategy, independent of farm size, commodity speciality, and region (Harwood et al., 1999). The next most highly ranked strategy for both types of Norwegian farmers was *prevent and reduce crop diseases and pests*, followed by *buying farm business insurance*, and

Table 5. Mean score for conventional and organic cash crop farmers and varimax rotated factor loadings for risk management strategies (ranked by declining importance for conventional farmers)

Risk management strategies	Conventional Mean[1]	Organic Rank	Organic Mean[1,2]	Most important factors[3] 1	2	3	4	5	6	7
Liquidity – keep cash on hand	6.34	1	6.31				0.37	0.59		
Prevent/reduce crop dis. and pests	6.04	2	6.00				0.68			
Solvency, debt management	5.92	10	5.39***					0.65		
Buying farm business insurance	5.87	3	5.87			0.83				
Producing at lowest possible cost	5.81	5	5.59				0.73			
Take off-farm work	5.76	11	5.28*				−0.32	0.57		
Buying personal insurance	5.69	4	5.81			0.86				
Risk reducing technologies	5.42	7	5.49	0.35	0.35		0.41			
Small gradual changes[4]	5.36	14	5.05*							
Asset flexibility	5.32	8	5.47		0.75					
Use of agronomic/nutritional consultancies	5.18	6	5.50	0.69						
Prevent/reduce livestock diseases[4]	4.91	9	5.45							
Collecting information	4.71	16	4.81	0.49	0.40					
Production contracts	4.68	15	4.84	0.64						
Enterprise diversification	4.58	12	5.11**	0.51	0.45					
Shared ownership of equipment, joint operations	4.52	17	4.63	0.37						
Product and market flexibility	4.47	13	5.11**		0.75					
Co-operative marketing	4.41	20	4.40	0.44		0.34				
Keeping fixed costs low	4.37	18	4.50						0.71	
Storage	4.26	19	4.49	0.65						
Use of economic consultancies	4.17	21	4.28	0.58						
Surplus machinery capacity	3.82	23	3.25**							0.70
Use of veterinarian consultancies[4]	3.59	22	3.82							
Off-farm investments	3.50	24	2.70***							0.75
Organize the farm as a corporation	2.49	25	2.52					−0.45	0.42	0.42
% of total variation accounted for				20.4	7.7	7.5	6.0	5.4	5.1	4.9

[1]Mean score (1 = no impact, 7 = very high impact) for conventional and organic farmers. [2]Mean numbers marked with asterisks show that the mean scores of conventional and organic farmers are significantly different at $*P < 0.05$, $**P < 0.01$ and $***P < 0.001$, based on independent samples *t*-tests. [3]Factors 1 to 7 for risk management strategies are *business, flexibility, insurance, low cost, financial, fixed cost,* and *invest,* respectively. Factor loadings $< |0.30|$ are not shown. [4]Not included in the factor analysis.

producing at lowest possible costs. For Norwegian dairy farmers Flaten et al. (2004) found the same top ranking, except that *prevent and reduce crop diseases and pests* was replaced with *prevent and reduce livestock diseases*. Dairy farmers, compared to cash-crop farmers, considered off-farm work as a less important strategy to cope with risk.

For organic cash crop farmers *product and market flexibility*, and *enterprise diversification* were significantly more important than for conventional farmers. These findings may result from the smaller volume of organic markets with greater price fluctuations and from the likelihood that the interactions between enterprises are important for the overall financial performance of an organic farm (Padel & Lampkin, 1994b). Conventional farmers attached particularly greater importance than organic farmers to *solvency, debt management* and *off-farm investments*. These results may be related to the lower emphasis on 'economic goals' among organic farmers.

Less important strategies for farmers in general were, in declining order, *keeping fixed costs low, storage*, use of both *economic and veterinarian consultants and services, surplus machinery capacity, off-farm investments*, and *organize the farm as a corporation*. The bottom rating strategy of *corporate farming* indicated that most farmers did not consider this as suitable for reducing risk.

A joint factor analysis applied to 22 of the 25 presented risk management strategies resulted in seven factors with eigenvalue above 1. Two items were excluded because they related to livestock production, and one because it had low loadings on all of the extracted factors. The Kaiser-Meyer-Olkin measure for the whole set of variables was 0.796, which means that the variables were suitable for factor analysis. The MSA and communalities for each variable were satisfactory. The factor loadings for the individual variables are shown in Table 5. The seven factors explained 57% of the total variation in the 22 variables. The structure was more complicated than for the risk perceptions.

The first factor, *business*, includes general business risk reducing methods; the most important are *consultancy*, *storage, contracting*, and *diversification*. The next factor, named *flexibility*, has high loadings on product, market, and asset flexibility and diversification. Both *farm business* and *personal insurance* dominates the factor *insurance*. High loadings from the strategy to *produce at lowest possible cost* gave the name to factor 4, *low cost*, which also includes preventing or reducing *crop diseases and pests*. Factor 5, *financial*, includes mainly *solvency, debt management*, *liquidity – keeping cash on hand*, and *off-farm work*. *Keeping fixed costs low*, labelled factor 6, *fix cost*. *Investing off-farm* and *keeping surplus machinery capacity* are strategies that help to manage risk, mainly by investing money. Therefore factor 7 was labelled *invest*.

4.6. Perception of risk sources in relation to farm and farmer characteristics

Stepwise regressions were used to assess the associations of the risk perception factors with the independent variables (Table 6).

Institutional sources of risk were less important for farmers with high leverage and low degree of risk aversion. Farmers' rating of *institutional sources of risk* was positively related to the proportion of grain area on the farm. This may be a result of a higher degree of governmental intervention in Norwegian grain farming than in the horticultural sector. The *external organic* factor was of course a main source of risk for organic farmers, but was less important for farmers with livestock production and those with a higher proportion of vegetables or fruits. This may indicate that farmers perceived organic regulations and premiums in Norway as more risky for pure cash crop farming (except vegetables and fruits) than for mixed crop-livestock production. This may be a reason for why few pure cash crop farmers convert to organic agriculture in Norway. The same has been reported from other countries (Schneeberger et al., 2002). Risks linked to *human resources* were less important for farmers with no spouse. A *total high farm-income* and *off-farm work* helped to reduce this source of risk, whereas farmers with secondary school education were more aware of this. Leveraged farmers were, as expected, particularly aware of risk related to *credit*, the same was found for large-sized farms (measured as hectares farmland). Education above secondary school level tended to reduce the concern for risk connected to *credit*. Organic farmers were less concerned with these types of risk. *Crop* risks were especially important to farmers with a higher proportion of grain, vegetables or fruits. *Market* risks were of high importance for high farm-income respondents, for those with higher education, and farmers who were less risk averse. Farmers with more grain production felt less exposed to market risks.

All regressions were highly significant at $P < 0.05$. The goodness of fit measure for some of the factors indicated that the variables used were either not very suitable to explain the variation or that farmers' perception of these risks were very farmer specific.

4.7. Risk management strategies in relation to farm and farmer characteristics

The estimated relationships between farm and farmer characteristics, sources of risk and risk management strategies, analysed through stepwise regression, are presented in Table 7.

Farmers with lots of land and those with an agricultural education more frequently assigned importance to the *business* risk management strategies. The difference was significant. A large proportion of vegetables or fruits and the goal to produce *high quality food* were positively related to this factor. Profit-maximizing farmers and single farmers perceived the *business* strategies as being less important. *Flexibility* seems to be of less importance with increasing age of the farmer and of higher importance with decreasing degree of risk aversion. Leveraged farmers perceived insurance as more important. More risk averse farmers seemed to be more interested in buying insurance. The *low-cost* strategy was preferred by farmers with high income from farming, with a high leverage, and of older age. The importance of the *financial* strategy was higher for farmers with off-farm work and a higher proportion of grain, but it was perceived as less important for farmers with *high farm income*, *secondary school education*, and *agricultural education*. To be aware of *fixed cost* was associated with higher education, off-farm work, and off-farm investments. The strategy *invest* was highly rated by farmers who had invested off-farm, who had a total high income, those with a large proportion of grain area, and those who were less risk averse. Organic farmers were less concerned about the *invest* strategy.

Table 6. Results of multiple regressions for risk sources against socio-economic variables

Independent variables[2]	Sources of risk[1]					
	Institutional	External organic	Human resources	Credit	Crop	Market
Farmer						
Risk attitude[3]	−0.13					0.14
Secondary school[4]			0.25			
College or university[5]				−0.23		0.27
Marital status[6]			−0.43			
Economics						
Farm income[7]			−0.22			0.59
Leverage[8]	−0.23			0.63		
Working off-farm[9]			−0.29			
Farm						
Farmland (ha)				0.13		
% grain of farmland	0.30		*−0.25*		0.16	−0.11
% veget./fruits of farmland		−0.10			0.18	
Livestock[10]		−0.20				
Organic farming[11]		1.27		−0.24		
df:	378	378	376	377	379	377
R^2_{adj} (all P-values <0.05)	0.14	0.26	0.07	0.12	0.02	0.11

[1]Coefficients in italics indicate variables with a P-value between 0.05 and 0.10, the rest of the included variables have P-values less than 0.05. Coefficients for dummy variables are unstandardized, all other coefficients are standardized. [2]The variables *formal agricultural education, age of farmer, household income, off-farm investment in the last five years, % potatoes of farmland,* and *region* were tested in the models but found to be not significant. [3]A simple measure of risk attitude. Aggregate of willingness to take risk. [4]Measured as a dummy variable where 1 denotes highest level of education at secondary school level and 0 denotes otherwise. [5]Measured as a dummy variable where 1 denotes highest level of education at college or university level and 0 denotes otherwise. [6]Measured as a dummy variable where 1 denotes main operator was single and 0 denotes otherwise. [7]Measured as a dummy variable where 1 denotes a farm income ≥NOK 200,000 and 0 denotes otherwise. (€ 1 ≈NOK 8.29.) [8]Measured as a dummy variable where 1 denotes that relation debt/equity was ≥0.5 for the respondent and 0 denotes otherwise. [9]Measured as a dummy variable where 1 denotes that the farmer/family had off-farm work and 0 denotes otherwise. [10]Measured as a dummy variable where 1 denotes livestock production on the farm and 0 denotes otherwise. [11]Measured as a dummy variable where 1 denotes organic farming and 0 denotes otherwise.

Institutional risk was positively related to the *low cost* strategy and *financial* management responses. *External organic* risk sources were positively related to *business* and *flexibility* responses, but negatively to the *low cost* strategy. Both *human resources* and *credit* risk led farmers to the *invest* strategy. The rated importance of *business* strategies was related to the perceived impact of risk factors labelled *credit*, *crop* and *market*. In addition, *low cost* and *financial* strategies were well known to handle *crop* risks. Many different strategies were related to *market risks*. In addition to earlier mentioned strategies there were positive associations between *market risk* and the strategies *flexibility*, *insurance* and *financial*.

All regressions were highly significant at $P < 0.05$. The goodness of fit measure for some of the factors indicate that the variables used were either not very suitable to explain the variation or that farmers' perception of these risks were very farmer specific.

5. Conclusions

The objective of this study was to obtain empirical insight into cash crop farmers' perception of risk and risk management strategies. A questionnaire survey was carried out among Norwegian farmers.

The survey results indicate that organic farmers ranked sustainable and environmental friendly farming as goal number one; they focused less on economic goals. By contrast, the top goal for conventional farmers was to achieve a reliable and stable income. Organic farmers perceived themselves to be less risk averse than their conventional colleagues.

Crop prices and yield variability were the two top rated risk sources for both groups of farmers. In general, institutional sources of risk were perceived as important. While conventional farmers ranked sources of risk linked to costs of purchased inputs higher, organic farmers were more aware of external organic sources such as additional organic farming payments,

Table 7. Results for multivariate regression for risk management strategies

Independent variables[2]	Risk management strategies[1]						
	Business	Flexibility	Insurance	Low cost	Financial	Fix cost	Invest
Farmer							
Risk attitude[3]		*0.10*	−0.11				0.10
Secondary school[4]					−0.24		
College or university[4]						0.22	
Agricultural education[5]	*0.18*				−0.23		
Age of farmer (years)		−0.11		0.13			
Marital status[6]	*−0.24*						*0.29*
Economics							
Farm income[7]				0.31	−0.31		
Household income[8]							0.23
Leverage[9]			0.22	0.23			
Working off-farm[10]					0.38	*0.19*	
Off-farm investment[11]						*0.18*	0.39
Farm							
Farmland (ha)	0.31		*0.09*				
% grain of farmland					0.15		0.12
% potatoes of farmland	*0.08*						
% veg./fruits of farmland	0.11						
Organic farming[12]							−0.30
Farming goals[13]							
High quality food	0.20						*−0.17*
Maximize profit	−0.23						
Sources of risk[14]							
Institutional				0.22	0.15		
External organic	*0.08*	0.21		−0.10			
Human resources		*0.09*	*0.08*				0.19
Credit	0.15				*−0.09*	*0.10*	0.13
Crop	0.17			0.15	0.12		
Market	0.20	0.14	0.13		0.13		
df:	370	376	376	374	372	377	372
R^2_{adj} (all *P*-values <0.05)	0.28	0.10	0.04	0.16	0.18	0.03	0.15

[1]Coefficients in italics indicate variables with a *P*-value between 0.05 and 0.10, the rest of the included variables have *P*-values less than 0.05. Coefficients for dummy variables are unstandardized, all other coefficients are standardized. [2]A number of farming goals (*reliable and stable income, children, family, animals on farm,* and *sustainable, environmental farming*) and region were tested in the models, but were not significant. [3]A simple measure of risk attitude. Aggregate of willingness to take risk. [4]Measured as a dummy variable where 1 denotes highest level of education as mentioned and 0 denotes otherwise. [5]Measured as a dummy variable where 1 denotes formal agricultural education and 0 denotes otherwise. [6]Measured as a dummy variable where 1 denotes main operator was single and 0 denotes otherwise. [7]Measured as a dummy variable where 1 denotes a farm income ≥ NOK 200,000 and 0 denotes otherwise. [8]Measured as a dummy variable where 1 denotes a household income ≥ NOK 500,000 and 0 denotes otherwise. [9]Measured as a dummy variable where 1 denotes that relation debt/equity was ≥0.5 for the respondent and 0 denotes otherwise. [10]Measured as a dummy variable where 1 denotes that the farmer/family had off-farm work and 0 denotes otherwise. [11]Measured as a dummy variable where 1 denotes the farmer/family had invested off-farm the last five years and 0 denotes otherwise. [12]Measured as a dummy variable where 1 denotes organic farming and 0 denotes otherwise. [13]Measured as a dummy variable where 1 denotes the farmer mentioned the goal as important and 0 denotes otherwise. [14]Variables from the factor analysis for each farmer are used.

price premiums on organic products, and organic farming laws and regulations.

The two groups of farmers evaluated risk management strategies more similarly. Favoured strategies were good liquidity, preventing and reducing crop diseases and pests, different forms of insurance and low cost production. For organic farmers, product flexibility and enterprise diversification were perceived to be more important. Conventional farmers rated *solvency* and *off-farm investment* higher.

Different sources of risk and risk management strategies were related to socio-economic variables. The results indicate that farmers perceived organic regulations and premiums in Norway as more risky for pure cash crop farming (except vegetables and fruits) than for mixed crop-livestock production. The strongest associations were found between *credit* risk and highly leveraged farmers, and between *market* risks and high farm income. Of the management responses, *financial* and *working off-farm* were strongly related.

Because of the sampling method used, the results can be taken to be representative for organic and conventional cash crop farmers in Norway. The high support payments and high degree of regulation of agriculture in Norway obviously influences our results. Nevertheless, the agricultural policy system and regulations for farming practices are not very different from what is found in some other developed countries across the Northern Hemisphere. This implies that similar results also might be found in several other countries.

The study revealed notable differences between organic and conventional cash crop farmers' risk perceptions and priorities for ways to handle risk, suggesting that government policies may have to be applied differently to the groups. Both groups of farmers were, however, worried about the institutional risks, indicating the importance of an agricultural policy that is clear, stable and predictable. Policy makers should therefore be cautious about changing policy capriciously and they should consider strategic policy initiatives that give farmers more long-term reliability. One step in a more stable and predictable direction in Norway would be a change from annual to perennial agricultural negotiations between the farmers' unions and the government.

Since the questionnaire showed that several risk factors are of importance for crop farmers, those dealing with them ought to provide better information to enable them to make better-informed judgements about the risks they face. Farm management consultants and advisers should make more use of modern decision analysis tools that incorporate the main sources of risk.

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Vedlegg 3

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Comparing risk perceptions and risk management in organic and conventional dairy farming: empirical results from Norway

O. Flaten[a,*], G. Lien[a], M. Koesling[b], P.S. Valle[c], M. Ebbesvik[b]

[a]*Norwegian Agricultural Economics Research Institute, Box 8024 Dep., Oslo NO-0030, Norway*
[b]*The Norwegian Centre for Ecological Agriculture, Tingvoll NO-6630, Norway*
[c]*Institute of Livestock Medicine, The Norwegian School of Veterinary Science, Box 8146 Dep., Oslo NO-0033, Norway*

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Abstract

This study was conducted to explore organic and conventional dairy farmers' perceptions of risk and risk management, and to examine relationships between farm and farmer characteristics, risk perceptions, and strategies. The data originate from a survey of conventional (n=363) and organic (n=162) dairy farmers in Norway. Organic farmers had the least risk averse perceptions. Institutional and production risks were perceived as primary sources of risk, with farm support payments at the top. Compared to their conventional colleagues, organic farmers gave more weight to institutional factors related to their production systems. Conventional farmers were more concerned about costs of purchased inputs and animal welfare policy. Organic and conventional farmers' management responses were more similar than their risk perceptions. Financial measures such as liquidity and costs of production, disease prevention, and insurance were perceived as important ways to handle risk. Even though perceptions were highly farmer-specific, a number of socio-economic variables were found to be related to risk and risk management. The primary role of institutional risks implies that policy makers should be cautious about changing policy capriciously and they should consider the scope for strategic policy initiatives that give farmers some greater confidence about the longer term. Further, researchers should pay more attention to institutional risks.

Keywords: Risk; Risk management; Dairy farming; Organic farming; Questionnaire; Multivariate analysis

1. Introduction

Farmers' perceptions of and responses to risk are important in understanding their risk behaviour. In the literature, much normative analysis (with mathematical programming, etc.) has been done to show how farmers should behave under uncertainty (e.g., Hardaker et al., 2004). Surprisingly, however, less work has been done to examine how farmers perceive risk and manage it in practice.

Organic farmers are exposed to additional and different sources of risk compared to conventional

* Corresponding author. Tel.: +47 22 36 72 55; fax: +47 22 36 72 99.
E-mail address: ola.flaten@nilf.no (O. Flaten).

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farmers. Restrictions on pesticide use, fertilisers, synthetic medicines, purchase of feeds, etc., influence production risk. Smaller organic markets may mean greater price fluctuations. On the other hand, specific direct payments in organic farming result in greater income stability (Offermann and Nieberg, 2000, p. 93). At the same time, and for both production types, uncertainty about future government payments may be of concern to farmers.

Surveys have been conducted by asking about the types of risk perceived as most important by conventional farmers and about the management strategies the farmers use. Harwood et al. (1999) have summarised US studies. US farmers, including dairy farmers, were most concerned about commodity price risk, production risk, and changes in government laws and regulations. Arizona dairy producers perceived the costs of operating inputs to be the greatest source of risk (Wilson et al., 1993). A 1996 USDA survey (reported in Harwood et al., 1999) found that keeping cash on hand was the chief risk management strategy for every farm size, for every commodity specialty, and in every region studied. Use of derivative and insurance markets was also considered important. In a recent study (Hall et al., 2003), beef producers in Texas and Nebraska perceived severe droughts and cattle prices as the most important risk factors. Maintaining animal health was viewed as the most effective strategy.

Dairy farmers in New Zealand ranked price risk and rainfall variability highest, met by routine spraying, drenching, and maintaining feed reserves (Martin, 1996). Meuwissen et al. (2001) found that Dutch livestock farmers considered price and production risks to be most important. Producing at lowest possible costs and insurance were the most important risk management strategies. A study among Finnish farmers found changes in agricultural policy as the most important risk factor, while maintaining adequate liquidity and solidity was the most important management response (Sonkkila, 2002).

A few studies have found that geographic location, farm type, institutional structures, and other factors affecting the operating environment of farmers influenced farmers' perceptions of risk and risk management (Boggess et al., 1985; Wilson et al., 1993; Patrick and Musser, 1997; Meuwissen et al., 2001). The studies also pointed to "the highly complex and individualistic nature of risk perceptions and selection of management tools" (Wilson et al., 1993).

As far as we know, no earlier studies have compared conventional and organic farmers' risk perceptions and risk management strategies. In Norway, no studies at all have explicitly investigated dairy farmers' risk perceptions and the ways they deal with the risks.

This relative lack of information about (especially organic) farmers' risky environment and their reactions to it means that there are few useful practical insights for policy makers, farm advisers, and researchers. The objectives of this study are: through an exploratory and descriptive study, to provide empirical insight into: 1) Norwegian dairy farmers' risk perceptions and risk management responses; 2) differences in risk perceptions and management responses between conventional and organic dairy farmers; and 3) farm and farmer characteristics related to the perceptions and strategies. The data are analysed with modern multivariate techniques.

2. Conceptual framework

Economists have traditionally used one theory of risky choice to serve both normative and descriptive purposes (Thaler, 2000). Expected utility theory is the most widely accepted normative model of rational choice (Meyer, 2002) that economists have used also as a descriptive model of decision making under risk (Thaler, 2000). Numerous studies have, however, criticised the expected utility hypothesis on descriptive grounds because it fails to describe observed behaviour (Kahneman and Tversky, 1979; Allais, 1984; Moschini and Hennessy, 2001, Rabin and Thaler, 2001). The best way to describe decision-making behaviour, according to Slovic et al. (1982), March and Shapira (1987), and Priem et al. (2002), is to understand the individual's frame of reference for evaluating choices with uncertain outcomes because the decision maker's perceptual world is that person's reality and forms the basis for her or his choices.

This paper will use a descriptive approach, where we aim to characterise how Norwegian dairy farmers perceive and manage risk. Because of organic farmers' exposure to additional and different sources of risk compared to conventional farmers, we expect

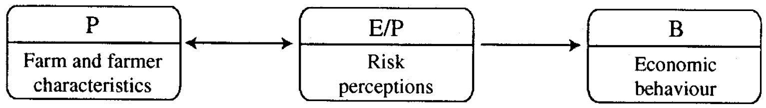

Fig. 1. Elements of Van Raaij's (1981) model of a firm's decision-making environment.

these to influence their risk perceptions and management responses. For example, organic farmers purchase less of variable inputs, and we thus expect organic farmers to be less susceptible financially to input price shocks. The lack of earlier comparative studies, however, makes it hard to develop firm hypotheses. Instead, we will explore and identify differences between organic and conventional farmers in their assessed importance of various sources of risk and their management responses of these risks.

We do not expect either group of farmers to be a homogeneous population since we expect different farm and farmer characteristics to influence their risk perceptions and management responses. Van Raaij's (1981) model of the decision-making environment for the firm is useful to study the relationship between farm and personal characteristics, risk perceptions, and management responses (e.g., Wilson et al., 1993). Fig. 1 presents the groups of variables used in our research design. The other elements of Van Raaij's model are excluded.

First, $P \rightarrow E/P$ describes how farm and personal variables (P) impact on farmers' perceptions of risk factors (E/P). Second, the relationship $P \rightarrow E/P \rightarrow B$ reflects how the farm/personal variables and risk perceptions influence economic behaviour (B) (i.e., their risk management strategies). Best use of intuition and prior insights from research in other countries were used in the selection of variables.

3. Materials and methods

3.1. Data

The data reported here were collected as a part of a larger questionnaire survey of risk and risk management in farming. Samples were selected from Norwegian crop and dairy farmers. This paper examines data from dairy farmers; an analysis of the data from crop farmers is reported in Koesling et al. (2004). Because of small herd sizes in Norway, dairy farms were defined as farms having more than five dairy cows.

The 10-page questionnaire consisted of questions related to: 1) farmers' perceptions of risk (including questions on risk attitude and sources of risk); 2) farmers' perceptions of various risk management strategies; 3) farmers' goals, future plans, and motivations for their farming system (organic or conventional); 4) animal disease management strategies; and 5) characteristics of the farm and farmer. Most questions were of the closed type, many in the form of seven point Likert-type scales. The questionnaire was both pretested internally and in sessions with farmers, and refined over several stages based on the comments and suggestions received.

The Norwegian Agricultural Authority (SLF) has a register of farmers who receive support payments (i.e., all farmers), including each farmer's stocking and cropping details. Dairy cow health and production records are registered in the Norwegian Herd Recording System, in which 96.5% of the dairy farmers participate (Østerås, 2003). These two data sets (2002 data) were merged with the survey data.

3.2. Sample

The questionnaire was first sent out in January 2003 to 616 randomly selected conventional dairy farmers and all 245 registered organic dairy farmers. Conventional farmers were selected from the SLF register of farmers who received support payments based on their 2001 application. A month later, a reminder postcard was sent to all nonrespondents. In March, nonrespondents were mailed with a follow-up letter and another copy of the questionnaire.

From the original 861 dairy farmers (in 2001) approached, 383 (62.2%) conventional and 161 (65.7%) organic farmers responded. Six conventional respondents informed us that they had quit farming. Seven conventional and two organic farmers had quit dairying. Five dairy respondents had converted to organic farming methods and one from organic to conventional farming. Two originally nondairy respondents had started organic dairy farming. Three conventional and three organic responses were discarded because of very incomplete returns. The questionnaires of 363 conventional and 162 organic farmers (in 2002/2003) were then available for statistical analysis. Because of the sampling strategy used and the high response rate, the samples are assumed to be representative of the conventional and organic dairy farmer populations.

3.3. Statistical analyses

All computations were conducted using the SAS statistical program package (v. 8.2). As a first step, farmers' perceptions of risk and risk management were studied using descriptive statistical analyses. Mean values obtained in organic and conventional farming for a variable were compared by t tests, omitting an observation if it had a missing value. Standard parametric statistical procedures were assumed appropriate for ordinal variables in the form of Likert-type scales (e.g., Patrick and Musser, 1997; Meuwissen et al., 2001).

Common factor analysis, from an exploratory perspective, was employed to summarise the information in a reduced number of factors. The latent root criterion (eigenvalue >1) was first used as a guideline in determining how many factors to extract. In order to have the most representative and parsimonious set of factors possible, factor solutions with different numbers of factors were also examined before structures were defined (Hair et al., 1998). Orthogonal (varimax) rotation was used, to ensure inter alia that the factors were as independent as possible for subsequent use in regressions. Standardised factor scores for each farmer and factor were saved for subsequent multivariate analyses.

Some 40% of the respondents did not answer one or more relevant questions about sources of risk or management responses (Table 1). In cases with missing data, most of the respondents failed to answer only a few items. If remedies for missing data are not applied, any observations with missing values on any of the items are omitted. Using only complete observations can produce bias in the results unless the missing observations are missing completely at random. There is also a loss of precision as the sample

Table 1
Number of unanswered questions on sources of risk[a] (n=31) across risk management strategies (n=25) within categories of groups

	Groups	Sources of risk					
		0	1–5	6–11	12–20	>20	Total
Risk management	0	315	78	2	1	3	399
	1–5	65	33	2	0	1	101
	6–13	6	4	0	0	0	10
	>13	7	1	2	0	5	15
	Total	393	116	6	1	9	525

[a] A total of 33 variables were presented, but two crop farm-specific sources of risk are excluded.

size is reduced (Hair et al., 1998). Our approach for dealing with missing data in these factor analyses was first to delete cases having answered less than 20 of the risk source variables or 12 of the risk management strategies variables. Next, missing data points were replaced with the mean value of that variable based on all valid responses in the group (conventional or organic).

Organic and conventional farmers may have different risk perceptions but some preliminary analyses revealed very similar factor structures among risk sources and management responses. Therefore joint factor analyses for the two groups of farmers were carried out.

The factor scores from the risk attitude questions were submitted to a nonhierarchical cluster analysis to search for groupings of farmers with similar risk attitudes. The sequential threshold method, combined with the least square optimisation criterion, was used to select cluster seeds (Hair et al., 1998). Creating the risk attitude variable by use of cluster analysis, rather than identifying the risk groups by using, for example, median split reduces the chance of arbitrariness when identifying groups.

Multiple (ordinary least square and logistic) regressions were used to study associations between farm and farmer characteristics, risk perceptions, and risk management, as outlined in Fig. 1. An observation was excluded from the analysis, if any variable needed for a regression was missing (e.g., a categorical farm or farmer characteristic). Simple correlation coefficients between all pairs of independent variables were low. Variance inflation factors were close to 1 and condition indices were low, indicating no multicollinearity problems (Belsley et al., 1980). No heteroskedasticity was detected using the White test

Table 2
Comparison of average characteristics of dairy farms in survey with averages of dairy farms in Norway[a]

Characteristics	Conventional		Organic	
	Average of farms in survey (n=363)	Average of farms in Norway (18,300)[b]	Average of farms in survey (n=162)	Average of farms in Norway (325)[b]
Number of dairy cows[b]	16.9	15.8	16.8	16.8
Milk yield per cow[c] (kg)	6193	6150	5119	5070
Concentrates[c] (FUm[d]/cow)	1649	1706	887	866
Farmland (ha)[b]	25.8	23.3	30.3	30.2
Labour units (man years)	2.1	–	2.1	–
Age of farmer[b]	47.5	51.6	47.2	52.1
Highest level of education[e] (%)	17/70/10/3	–	6/54/22/18	–
Agricultural education (%)	59.7	–	76.1	–
Farm income[f] (%)	54.8	–	46.8	–
Household income[g] (%)	42.2	–	50.3	–

[a] Information was also gathered on net worth and debt. Many refusals to answer precluded their use in the statistical analyses.
[b] Data (2002) from the Norwegian Agricultural Authority.
[c] Data (2002) from the Norwegian Herd Recording System.
[d] One feed unit milk (FUm) is defined as 6900 kJ of net energy lactation (Ekern, 1991).
[e] Primary school/high school/BSc/MSc.
[f] Percentage of respondents (spouse included) with farm income ≥NOK (Norwegian kroner) 200,000. € 1 ≈ NOK 8.40.
[g] Percentage of respondents (spouse included) with household income ≥NOK 350,000. Household income covers farm income, other forms of self-employment, wages, pensions, property income, and capital income.

(White, 1980). The stepwise regression method was tested. Compared to the complete models, signs of the coefficients were identical, magnitudes of the coefficients were quite similar, and levels of statistical significance of the independent variables were almost stable. The complete regression models were selected for reporting herein.

4. Results and discussion

4.1. General characteristics of respondents

The main characteristics of the dairy farm groups are compared in Table 2. The average farm size of conventional respondents was slightly larger than the average in Norway. Respondents were somewhat younger than the average dairy farmer.

Organic respondents farmed more land on average than conventional respondents. The average numbers of dairy cows was quite similar between the two groups, but organic cows were fed less concentrate and produced less milk. Labour input and farmers' age were quite similar on conventional and organic farms. Organic farmers had most years of schooling and more of them had agricultural education. Most respondents were organised as family farms: 93% of conventional and 88% of organic farms. Partnerships occurred on 6% of the farms.

4.2. Farmer's willingness to take risk

Farmers were asked to assess their willingness to take risk, compared to others, on Likert-type scales ranging from 1 (do not agree) to 7 (fully agree). The statements were "I am willing to take more risk than other with respect to: 1) production, 2) marketing, and 3) finance and investment," respectively. Patrick and Musser (1997) and Meuwissen et al. (2001) used similar statements.[1] We assumed that most farmers are risk averse, but they vary in their willingness to take risk (Hardaker et al., 2004, p. 92). Since statements measured attitude toward risks compared to others, the term comparative risk aversion (CRA) was used. Fig. 2 compares the percentage distribution of organic and conventional respondents' answers in relationship to the statements.

[1] The measures used to elicit farmers' risk preferences in all these studies, including ours, are simple approximations. More advanced methods to elicit farmers' risk attitude are discussed in, for example, Moschini and Hennessy (2001) and Hardaker et al. (2004).

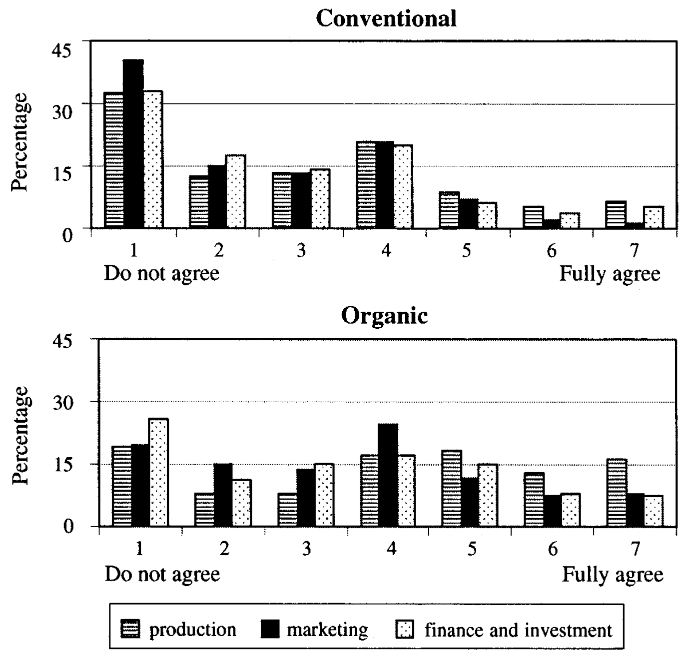

Fig. 2. Percentage distribution of organic and conventional respondents' comparative risk aversion.

Conventional dairy farmers generally perceived the extent to which they take risks to be less than that of others. By contrast, Fig. 2 shows that the responses of the organic dairy farmers had a more symmetric distribution over the scale of comparative risk aversion, especially with respect to production risks. Organic farmers' assessments were significantly less risk averse than their conventional colleagues (both production and marketing $P<0.001$; finance and investment $P<0.01$). Organic farmers have been few in numbers and the amount of experience with this form of production is somewhat restricted. Some willingness to take risk should therefore be expected among those adopting organic farming practices. Using historical data, Gardebroek (2002) also found organic farmers to be less risk averse than their nonorganic colleagues.

The three risk attitude questions all had significant positive correlations ($P<0.001$) ranging from 0.57 to 0.62. Kaiser's overall measure of sampling adequacy (MSA) was 0.717, suggesting that the matrix was suitable for factor analysis (Hair et al., 1998). Factor analysis of the variables resulted in a single factor with all three variables loading at 0.76 or higher and accounting for 73.7% of the total variance. The three risk attitude measures were summarised in a single variable (factor score).

The single factor scores from the factor analysis were used as input data in the cluster analysis; by this means it was possible to identify three distinct risk aversion clusters among the respondents. The cluster groups consisted of 210 farmers with "high risk aversion," 201 with "medium risk aversion," and 110 with "low risk aversion." Four respondents were excluded because of missing data. The three ordered categories of risk aversion were used in subsequent regressions.

4.3. Perceptions of sources of risk

In total, 33 sources of risk were presented to the respondents. Farmers were asked to score each source of risk on a Likert scale from 1 (no impact) to 7 (very high impact) to express how significant they considered each source of risk to be in terms of its potential impact on the economic performance of their farm.

Table 3
Mean score for conventional and organic farmers, and joint varimax rotated factor loadings for sources of risk

Sources of risk	Conventional mean[a]	Organic mean	Organic rank	Most important factors[b]					
				1	2	3	4	5	6
Changes in government support payments	**5.90	5.56	(1)	0.02	**0.43**	0.00	0.21	0.20	0.19
Changes in tax policy	***5.86	4.99	(6)	0.15	**0.50**	−0.13	0.20	0.22	0.24
Milk price variability	***5.81	5.28	(2)	0.26	**0.45**	−0.08	0.19	**0.47**	0.01
Milk quota policy	***5.56	4.83	(9)	0.22	**0.50**	0.02	0.06	**0.31**	0.02
Meat price variability	***5.55	4.72	(10)	0.26	**0.43**	−0.08	0.20	**0.37**	0.06
Animal welfare policy	***5.40	4.17	(17)	0.22	**0.69**	−0.03	−0.10	−0.12	0.07
Costs of operating inputs	***5.23	3.98	(21)	0.27	**0.40**	−0.17	**0.36**	0.28	0.09
Injury, illness, death of operator(s)	5.18	5.05	(5)	0.15	0.16	0.09	0.07	0.17	**0.75**
Changes in consumer preferences	5.17	5.10	(4)	0.13	0.05	0.04	0.04	**0.58**	0.15
Nondomestic epidemic animal diseases	**5.10	4.53	(13)	**0.53**	0.19	0.06	0.07	0.01	0.27
Domestic epidemic animal diseases	***4.96	4.16	(18)	**0.74**	0.19	−0.02	0.08	−0.01	0.24
Forage yields uncertainty	4.86	4.84	(8)	**0.53**	0.02	0.09	0.17	**0.32**	0.06
Other government laws and regulations	*4.78	4.40	(14)	0.13	**0.52**	0.19	0.20	−0.02	0.17
Cost of capital equipment	***4.74	3.87	(25)	0.30	**0.37**	−0.09	**0.33**	0.21	0.10
Fire damages	***4.59	3.86	(26)	**0.44**	0.19	−0.01	0.19	0.03	**0.40**
Cost of credit (interest rate)	**4.51	3.97	(22)	0.22	0.08	0.02	**0.73**	0.08	0.07
Crop prices variability	4.47	4.25	(16)	d.	d.	d.	d.	d.	d.
Technical failure	***4.46	3.90	(24)	**0.42**	0.23	0.02	0.28	0.13	0.20
Meat production variability	***4.43	3.71	(27)	**0.57**	0.25	0.05	0.20	0.25	0.09
Family members' health situation	4.40	4.11	(19)	0.24	0.16	0.07	0.10	0.13	**0.56**
Marketing/sale	*4.35	4.65	(11)	0.09	0.01	0.18	0.01	**0.54**	0.08
Changes in technology	***4.35	3.68	(28)	d.	d.	d.	d.	d.	d.
Crop yields variability	4.33	4.37	(15)	d.	d.	d.	d.	d.	d.
Legislation in production hygiene	4.28	3.93	(23)	0.24	**0.62**	0.18	−0.06	−0.08	0.09
Production diseases	*4.23	3.61	(29)	**0.67**	0.20	0.03	0.11	0.14	0.06
Milk yield variability	*4.17	3.53	(30)	**0.52**	0.25	0.04	0.19	0.21	−0.03
Hired labour	3.86	4.06	(20)	d.	d.	d.	d.	d.	d.
Credit availability	3.57	3.28	(33)	0.22	0.09	0.16	**0.65**	0.02	0.11
Uncertainty about family relations	3.31	3.30	(32)	d.	d.	d.	d.	d.	d.
Leasing farm land	3.31	3.40	(31)	d.	d.	d.	d.	d.	d.
Additional organic farming payments	***2.67	5.24	(3)	0.07	0.05	**0.84**	0.02	0.05	0.05
Organic farming laws/regulations	***2.27	4.63	(12)	0.02	0.08	**0.88**	0.02	0.06	0.08
Price premiums organic products	***2.24	4.91	(7)	0.02	−0.07	**0.88**	0.08	0.09	0.00
Percent of total variance explained	–	–	–	11.9	10.7	9.2	6.2	6.0	5.3
Cumulative percent of the variance explained	–	–	–	11.9	22.6	31.8	38.0	44.0	49.2

Ranked by declining importance for conventional farmers.
Mean numbers marked with asterisks show that the mean scores of conventional and organic farmers are significantly different at $^{*}P<0.05$, $^{**}P<0.01$ and $^{***}P<0.001$, based on independent samples t test.

[a] Mean score (1=no impact, 7=very high impact) for conventional farmers (n=363) and organic farmers (n=162).

[b] Factors 1– 6 are production, institutional, organic farming, credit, consumer demand, and human resources, respectively. Factor loadings >|0.30| are in **bold**. "d" means that the variable is deleted from the factor analysis because of low factor loading and low communality or farm-type conditionality.

The second and third columns of Table 3 compare average scores for conventional and organic farmers.[2] The fourth column shows organic farmers' ranking.

Uncertainty about the continuation of general government support payments stands out as the top-rated source of risk for both groups. Target prices and support schemes are decided in Norway through annual negotiations between the two farmers' unions and the government. High average rankings related to milk and meat prices are thus linked to farm policy.

[2] The standard deviations are not presented in Tables 3 and 4 because of the large size of the tables. The results are available from the authors.

Other highly ranked risks in general were institutional risks such as tax policy and milk quota policy.

Sources of risk that scored low include farmland leasing, family relations, credit availability, milk yield, production diseases, and hired labour.

Conventional farmers assigned more importance than organic farmers to many of the listed sources of risk. The less risk averse perceptions of organic farmers may have influenced the mean scores. The most pronounced differences were found in costs of operating inputs, animal welfare policy, and cost of capital equipment. The finding that organic farmers ranked input costs risk lower than conventional farmers is probably a result of production systems in organic farming with low levels of purchased inputs. At the time the survey was held a white paper on animal welfare was prepared (LD, 2002), maybe influencing the high score conventional farmers gave to animal welfare policy risks. Less pronounced anxiety among organic farmers for this source of risk is presumably because of already strict organic animal welfare standards. Organic farmers gave high scores to the specific, institutional "organic sources of risk" (the last three sources in Table 3). Beyond these, marketing/sales was the only source of risk where organic farmers' mean score was significantly higher than that for conventional farmers, maybe reflecting the higher instability in organic product markets.

Comparisons of risks (and management strategies) with previous studies are difficult because different questions were asked. Further, different farming, cultural, and risk environments complicate cross-national comparisons. However, the most outstanding finding, compared to previous United States, New Zealand, and Dutch studies, is the very high scores of many institutional risks. Agricultural policy changes, however, scored high in Finland (Sonkkila, 2002).

Since farming is typically a risky business, governments around the world have intervened to varying degrees to try to help farmers cope more effectively with risk. In this context it is a paradox that farmers perceived institutional risks as the most important. The domination of institutional risks may be related to somewhat unpredictable changes in Norwegian farm policies and regulations, together with external pressures for deregulation and associated fears of farm support cuts. The finding should also be linked to Just's (2003) proposal that longer term swings (e.g., lasting changes in agricultural policy) represent a much greater risk to farmers than year-to-year variability in payoffs because the downside consequences may be sufficiently prolonged to cause farm failure.

Joint factor analysis was applied to the data to reduce the number of risk source variables. The overall MSA was 0.850, suggesting that the matrix was suitable for factor analysis. The number of variables was reduced from 33 to 6. Some 49.2% of the total variance was accounted for. The latent root criterion suggested seven factors. The six-factor solution gave the most interpretable factors and was judged to be most useful. Variables conditional on farm type (crop yields and prices) were not included. Variables that did not load significantly on any factor (i.e., loadings $<|0.30|$) or whose communalities were low (<0.25) were also evaluated for possible deletion. Table 3 displays the six factors and their respective loading items after elimination of some variables.

The factors 1–6 are labelled "production," "institutional," "organic farming," "credit," "consumer demand," and "human resources" respectively. Factor 1, production, loads significantly from a variety of production variables and has the highest loadings of animal disease variables. A wide collection of public payment and government legislation variables indicates institutional risks in factor 2. Significant loadings of output and input prices could reflect the government's role in the pricing. Factor 3 is called organic farming because of the extremely high loadings of the three specific, institutional "organic" variables. Factor 4, credit, has large loadings of the interest rate and credit availability. Significant loadings of purchased inputs are likely to reflect the use of credit to these purposes in a farm business. Factor 5, consumer demand, involves high loadings of consumer preferences and marketing. Not surprisingly, some output price cross loadings are also significant. Heavy loadings of health and family variables and a cross loading of 0.40 of fire damage suggest human resources for factor 6.

4.4. Perceptions of risk management strategies

Some 25 risk management strategies were presented for the farmers' consideration. Farmers indicated their perceived importance of each strategy on a Likert scale from 1 (not relevant) to 7 (very relevant). Results are reported in Table 4.

Strategies generally perceived as very relevant were good liquidity, prevent and reduce livestock diseases, buy farm business insurance and personal insurance, and produce at the lowest possible cost. In recent studies of livestock farmers in other countries the same strategies were also perceived as most important (Meuwissen et al., 2001; Hall et al., 2003), even though national risk environments are quite different.

Farmers generally did not see corporate farm organisation, off-farm investments, surplus machinery capacity, collecting information, off-farm work, and use of price contracts as important strategies. The low ranking of collecting information could be a negative response to the need to collect still more information (inter alia related to quality assurance schemes) than to the importance of collecting information per se. Time-intensive dairy farming does not lend itself to off-farm work strategies, but 43% of the respondents perceived off-farm work as an important strategy (a score of 5 or higher). The low mean score assigned to price contracts may be because of the extensive use of cooperative marketing among Norwegian farmers and the Norwegian agricultural policy system, but livestock farmers in more deregulated countries have also ranked deriv-

Table 4
Mean score for conventional and organic farmers, and joint varimax rotated factor loadings for risk management strategies

Risk management strategies	Conventional mean[a]	Organic mean	Organic rank	Most important factors[b]						
				1	2	3	4	5	6	7
Liquidity—keep cash in hand	**6.50	6.19	(1)	0.08	0.20	0.07	0.20	−0.06	**0.50**	0.02
Prevent/reduce livestock diseases	*6.35	6.13	(2)	0.06	**0.64**	0.03	0.27	−0.09	0.22	0.10
Buying farm business insurance	*6.13	5.80	(3)	0.19	0.22	0.05	**0.63**	−0.04	0.11	−0.04
Producing at lowest possible cost	**5.94	5.61	(5)	0.09	0.29	0.03	0.09	−0.02	**0.33**	0.18
Buying personal insurance	**5.92	5.50	(6)	0.16	0.12	0.07	**0.83**	0.12	0.08	0.16
Risk reducing technologies	5.73	5.67	(4)	0.23	**0.46**	0.12	0.12	0.06	0.10	0.18
Solvency—debt management	***5.65	5.16	(9)	−0.05	0.02	0.06	−0.02	0.13	**0.78**	−0.05
Prevent/reduce crop diseases and pests	5.52	5.39	(7)	0.07	**0.71**	0.24	0.05	0.12	0.04	0.05
Use of agronomy/nutrition consultancy/services	*5.44	5.06	(10)	**0.66**	0.13	−0.03	0.12	−0.01	0.00	0.10
Small gradual changes	5.38	5.18	(8)	d.	d.	d.	d.	d.	d.	d.
Cooperative marketing	***5.35	4.78	(12)	d.	d.	d.	d.	d.	d.	d.
Use of veterinarian consultancy/services	***5.09	4.31	(16)	**0.65**	0.11	0.08	0.07	0.07	0.10	0.03
Asset flexibility	4.88	4.94	(11)	0.01	0.06	**0.47**	0.03	0.23	0.13	0.19
Shared ownership of equipment, partnership	4.87	4.64	(14)	0.13	0.14	−0.08	0.03	0.18	−0.01	**0.66**
Keeping fixed costs low	4.61	4.69	(13)	0.09	0.07	0.09	0.05	0.02	0.03	**0.39**
Use of economic consultancy/services	4.44	4.14	(19)	**0.66**	0.00	0.11	0.14	0.20	−0.03	0.15
Enterprise diversification	4.28	4.41	(15)	0.04	0.11	0.21	−0.09	**0.33**	0.00	0.18
Storage	4.16	4.08	(20)	0.05	0.12	**0.58**	0.07	−0.11	0.08	−0.15
Production contracts	4.07	4.03	(21)	0.17	0.15	**0.42**	0.07	0.07	0.03	−0.04
Off-farm work	4.02	4.01	(22)	0.09	0.03	−0.02	0.05	**0.41**	0.10	0.10
Collecting information	*3.79	4.22	(18)	0.19	0.14	0.24	−0.01	**0.34**	−0.06	0.17
Product and market flexibility	***3.40	4.24	(17)	−0.12	−0.02	**0.63**	−0.05	0.14	−0.05	**0.39**
Surplus machinery capacity	*3.39	3.05	(23)	d.	d.	d.	d.	d.	d.	d.
Off-farm investments	2.68	2.60	(24)	0.01	−0.10	0.05	0.04	**0.70**	−0.04	−0.05
Organise the farm as a corporation	2.39	2.20	(25)	d.	d.	d.	d.	d.	d.	d.
Percent of total variance explained	–	–	–	7.3	7.0	6.5	6.2	5.3	5.2	4.8
Cumulative percent of the variance explained	–	–	–	7.3	14.3	20.7	26.9	32.2	37.4	42.2

Ranked by declining importance for conventional farmers.
Mean numbers marked with asterisks show that the mean scores of conventional and organic farmers are significantly different at $*P<0.05$, $**P<0.01$ and $***P<0.001$, based on independent samples t test.

[a] Mean score (1=not important, 7=very important) for conventional farmers (n=363) and organic farmers (n=162).

[b] Factors 1–7 are consultancy, disease prevention, flexibility, insurance, diversification, and financial and fixed cost sharing. Factor loadings >|0.30| are in **bold**. "d." means that the variable is deleted from the factor analysis because of low factor loading and low communality.

ative instruments low (Martin, 1996; Meuwissen et al., 2001; Hall et al., 2003).

Organic and conventional farmers' perceptions of the importance of different management responses were much more similar than their perceptions about the sources of risk. Conventional farmers attached particularly greater importance than organic farmers to veterinary services, cooperative marketing, and solvency (debt management). The differences may be attributable to differences between the two production systems and the high importance of "noneconomic" goals among organic farmers. Organic farmers assigned significantly higher scores only to product and market flexibility and collecting information, but neither of these belonged to the risk strategies assigned high importance.

The overall MSA for the risk management variables was 0.736, suggesting that the matrix was suitable for factor analysis. The joint factor analysis identified seven factors with eigenvalues greater than one accounting for 42.2% of the variance. This solution gave interpretable and feasible factors and was used in the further analysis. Candidates for deletion were assessed in the same way as for the sources of risk. Table 4 displays the seven factors and their respective loading items after deletion of some variables.

The factors 1–7 are interpreted as "consultancy," "disease prevention," "flexibility," "insurance," "diversification," "financial," and "fixed cost sharing" respectively. Factor 1, consultancy, has high loadings of the consultancy services (veterinarian, agronomy/nutrition, and economics). Factor 2 is named disease prevention because of large loadings of prevention/reduction of crop/forage and livestock diseases and pests. A significant loading of risk reducing technologies accompanies the disease prevention strategies. Factor 3, flexibility, includes on-farm strategies to enhance flexibility (storage included) and price contracts. Factor 4 has heavy loadings of insurance contracts, and is accordingly labelled insurance. Off-farm (investments and work) and on-farm strategies to spread risk are included in factor 5, diversification. A significant loading of collecting information is also included. Factor 6 includes financial aspects of the farm business (solvency, liquidity, and production costs). Controlling fixed costs through shared ownership of equipment and partnership loads high on factor 7, fixed cost sharing. Moreover, another fixed cost strategy, keeping fixed costs low (e.g., through hiring land and machinery), and a cross loading of product and market flexibility load significantly.

4.5. Risk aversion and sources of risk in relation to farm and farmer characteristics

A multiresponse ordered logit model was used to examine the relationship between comparative risk aversion and socio-economic variables. For the sources of risk ordinary least square (OLS) multiple regressions were used. Regression coefficients and goodness-of-fit measures are presented in Table 5.

All models summarised in Table 5, except that for "human resources," were significant. Usually, goodness-of-fit is fairly low for discrete choice models (Verbeek, 2000, p. 186). The specified logit model performed 12% better than a model that specified the probability of take up to be constant. The goodness-of-fit coefficients in the significant OLS models were low, expect "organic farming," suggesting very personal perceptions and/or that important variables explaining farmers' perceptions have been excluded. Exclusion of many socio-economic variables of potential importance was judged not to be very likely. The extremely low debt/asset ratios and high liquidity measures often found in farming are, however, consistent with risk aversion (Musser and Patrick, 2002), as shown for a solvency measure in Meuwissen et al. (2001). These issues could not be examined in our study. Farmer specificity of perceptions is in line with previous studies (Boggess et al., 1985; Wilson et al., 1993; Patrick and Musser, 1997; Meuwissen et al., 2001).

Organic farmers had very significantly less comparative risk aversions (CRA) than conventional farmers, which is in agreement with the results presented in Fig. 2. Farmers having more dairy cows had a lower degree of CRA. Increased farm income implied, unexpectedly, higher degree of CRA. The last relationship may be of less economic importance, since it is the risk that threatens a farmer's long-term asset base that really matters (Just, 2003).

"Organic farming" was the only risk source organic farmers, compared to conventional farmers, perceived as significantly more important (columns 3–8). In relation to organic farmers, conventional farmers

Table 5

Results of multiple regressions for comparative risk aversion (CRA) and sources of risk against socio-economic variables[a] (n=457)

Independent variables	CRA[b]	Sources of risk					
		Production	Institutional	Organic farming	Credit	Consumer demand	Human resources
Farming system[c]	***0.96	***−0.35	***−0.52	***1.40	*−0.23	0.02	−0.01
CRA: ma-m[d]	n.i.	0.01	0.09	−0.05	−0.09	**0.28	(*)0.16
CRA: la-m[d]	n.i.	0.05	0.00	0.00	0.10	**0.31	−0.04
Ownership[e]	−0.06	0.12	−0.24	−0.16	0.03	0.00	0.19
Number of cows	*0.03	−0.01	−0.01	0.00	(*)0.01	0.01	0.00
Farm experience (year)	−0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education[f]	−0.07	−0.01	0.10	0.02	0.07	−0.03	0.02
Agricultural education[g]	0.13	−0.08	−0.09	(*)−0.14	0.07	0.13	0.00
Off-farm work[h]	(*)0.39	0.00	0.02	−0.13	0.03	(*)0.14	0.06
Off-farm investment[i]	−0.02	0.01	0.04	0.08	***−0.29	−0.12	0.05
SGM dairy (%)[j]	0.34	−0.10	0.40	−0.19	−0.02	−0.31	−0.34
Farm income[k]	*−0.49	−0.04	0.04	0.01	0.05	−0.03	−0.04
Household income[l]	0.34	−0.14	−0.13	−0.12	−0.11	−0.05	−0.02
Geography[m]	0.30	*0.23	0.10	−0.02	−0.11	0.03	−0.10
R^{2n}_{adj}	***0.121	***0.029	***0.081	***0.433	**0.037	*0.023	0.000

"n.i." stands for "not included."

[a] Variables and models significant at $^{(*)}P<0.10$, $*P<0.05$, $**P<0.01$ and $***P<0.001$.

[b] Measured as an ordered response variable where 1 denotes the most risk averse attitude, 2 the medium and 3 the least.

[c] Measured as a dummy variable where 1 denotes organic farming and 0 denotes conventional farming.

[d] Measured as two dummy variables "ma-m" and "la-m" where 0 denotes the medium risk averse attitude (m), and 1 denotes the most risk averse attitude (ma) and the least risk averse attitude (la), respectively.

[e] Measured as a dummy variable where 1 denotes partnerships and 0 denotes otherwise.

[f] Measured as a dummy variable where 1 denotes formal schooling beyond high school and 0 denotes high school education or less.

[g] Measured as a dummy variable where 1 denotes agricultural education and 0 denotes otherwise.

[h] Measured as a dummy variable where 1 denotes off-farm work (farmer and/or spouse) and 0 denotes no off-farm work.

[i] Measured as a dummy variable where 1 denotes off-farm investments the last five years and 0 denotes otherwise.

[j] Measured as percent of the farm's total standard gross margin (SGM) from the dairy enterprise.

[k] Measured as a dummy variable where 1 denotes farm income ≥NOK 200,000 and 0 denotes otherwise.

[l] Measured as a dummy variable where 1 denotes household income ≥ NOK 350,000 and 0 denotes otherwise.

[m] Measured as a dummy variable where 1 denotes central location (no regional policy priority) and 0 denotes otherwise (cf. KRD, 2003).

[n] The Nagelkerke approach was used to determine the coefficient of determination (pseudo-R^2) in the ordered logit model.

perceived production, institutional sources, and credit sources of risk as significantly more important, maybe related to their higher use of variable inputs.

Consumer demand was the only risk source factor that was significantly influenced by farmers' CRA. Both the most and least risk averse farmers found consumer demand risks more important than the medium risk averse farmers.

Of the other socio-economic characteristics, only off-farm investments and location had significant effects on the perceptions of risk sources. Farmers who had invested off-farm perceived credit risks as much less relevant, perhaps because their credit obligations are small. Farmers in central areas were more concerned about production risks, especially associated with the animal disease variables. The finding may be related to more frequent experiences with disease outbreaks in central areas (Norström et al., 2000; Nyberg et al., 2004) and therefore greater fear of these risk sources. Also, a higher frequency of livestock trade (Østerås, personal communication) and more densely populated areas may contribute to the greater disease concerns.

4.6. Perceptions of risk management in relation to farm and farmer characteristics

The last step was to use multiple linear regressions to relate the information on socio-economic characteristics and risk perceptions to management responses.

Table 6
Results of multiple regressions for risk management strategies[a] (n=457)

Independent variables	Risk management strategies						
	Consultancy	Diseases	Flexibility	Insurance	Diversification	Financial	Fixed cost
Farming system[b]	(*)−0.22	(*)0.22	(*)0.24	−0.07	−0.17	−0.09	−0.06
CRA: ma-m[c]	*−0.18	*0.19	−0.07	0.13	−0.05	0.13	0.04
CRA: la-m[c]	0.04	*0.26	0.16	(*)0.20	0.10	−0.02	*0.22
Ownership[d]	−0.15	−0.09	−0.05	−0.12	0.05	−0.21	**0.45
Number of cows	0.00	0.01	0.00	*0.01	0.00	0.00	0.01
Farm experience (year)	−0.01	0.00	−0.01	*−0.01	**−0.01	*0.01	0.00
Education[e]	0.03	−0.12	0.02	−0.15	(*)0.17	0.15	0.11
Agricultural education[f]	0.02	−0.08	0.10	0.06	0.07	0.09	**0.21
Off-farm work[g]	0.06	0.03	**−0.27	**0.26	(*)0.14	−0.09	0.02
Off-farm investment[h]	0.11	−0.08	−0.02	−0.08	***0.40	−0.04	(*)−0.14
SGM dairy (%)[i]	0.01	*−0.65	*−0.64	−0.25	0.05	0.30	(*)−0.45
Farm income[j]	0.04	0.02	−0.06	0.09	−0.03	0.06	−0.03
Household income[k]	−0.03	−0.02	0.04	0.10	−0.01	−0.01	−0.03
Geography[l]	−0.07	0.07	**0.26	*−0.18	−0.06	−0.13	−0.07
(1) Production[m]	***0.15	***0.18	***0.19	(*)0.08	0.06	**0.14	0.01
(2) Institutional	0.03	*0.10	(*)0.09	0.01	0.04	***0.18	0.02
(3) Organic farming	−0.03	−0.06	0.02	−0.07	(*)0.09	(*)−0.10	*0.11
(4) Credit	***0.17	(*)0.09	0.07	0.05	0.03	−0.07	*0.11
(5) Consumer demand	0.08	*0.10	0.06	0.05	0.01	−0.03	0.02
(6) Human resources	0.03	0.04	0.00	(*)0.09	0.03	*0.11	−0.04
R^2_{adj}	***0.088	***0.082	***0.128	***0.085	***0.102	***0.119	***0.088

[a] Variables and models significant at (*)$P<0.10$, *$P<0.05$, **$P<0.01$ and ***$P<0.001$.
[b] Measured as a dummy variable where 1 denotes organic farming and 0 denotes conventional farming.
[c] Measured as two dummy variables "ma-m" and "la-m" where 0 denotes the medium risk averse attitude (m), and 1 denotes the most risk averse attitude (ma), and the least risk averse attitude (la), respectively.
[d] Measured as a dummy variable where 1 denotes partnerships and 0 denotes otherwise.
[e] Measured as a dummy variable where 1 denotes formal schooling beyond high school and 0 denotes high school education or less.
[f] Measured as a dummy variable where 1 denotes agricultural education and 0 denotes otherwise.
[g] Measured as a dummy variable where 1 denotes off-farm work (farmer and/or spouse) and 0 denotes no off-farm work.
[h] Measured as a dummy variable where 1 denotes off-farm investments the last 5 years and 0 denotes otherwise.
[i] Measured as percent of the farm's total standard gross margin (SGM) from the dairy enterprise.
[j] Measured as a dummy variable where 1 denotes farm income ≥NOK 200,000 and 0 denotes otherwise.
[k] Measured as a dummy variable where 1 denotes household income ≥NOK 350,000 and 0 denotes otherwise.
[l] Measured as a dummy variable where 1 denotes central location (no regional policy priority) and 0 denotes otherwise (cf. KRD, 2003).
[m] Variables numbered "1–6" refer to sources of risk (from the factor analysis).

The regression coefficients and the goodness-of-fit measures of the models are presented in Table 6. All models were highly significant and all of them explained around 10% of the total variance.

Organic farmers tended to perceive flexibility and disease prevention as more important and consultancy as less important than the conventional farmers. Compared to other farmers, the most risk averse farmers perceived disease management strategies as significantly more important and found consultancy less important. The least risk averse farmers were more likely to view disease prevention and fixed cost sharing as important management responses.

All socio-economic variables, except education and the two income variables, had at least one significant relationship with the risk management strategies. In contrast, earlier studies have found some relationships between economic variables (like gross farm income and solvency) and farmers' perceptions of risk sources and management responses (Patrick and Musser, 1997; Meuwissen et al., 2001).

Farmers in partnerships perceived fixed cost sharing as more relevant than the others (mostly family farms). Farmers with larger herds were more likely to perceive insurance as relevant. More experienced farmers were significantly less concerned about insurance and diversification but found financial management responses more important. Farmers with education in agriculture placed more emphasis on fixed cost sharing. Off-farm work was associated with more importance assigned to insurance responses and less importance given to (on-farm) flexibility responses. Not surprisingly, investing off-farm was highly associated with diversification strategies. The most specialised dairy farmers perceived flexibility and disease prevention as less relevant. Farmers in central areas found flexibility more important, while insurance was of less concern.

The final independent variables are the perceived risk sources. An essential question is: How do farmers cope with the institutional risks? The regressions suggested that institutional risks are highly related to financial management responses (solvency, liquidity, and low cost production). Disease prevention was also of importance. The results indicate multidimensionality of institutional risks requiring multiple management responses. More creative ways to handle risk than the traditional ones referred to in the survey may also be needed (Boehlje, 2003).

Production risks were found to be highly associated with multiple management responses; consultancy, disease prevention, flexibility, and financial strategies. No one-to-one correspondence between sources of, and responses to, risk has also been observed previously (Patrick and Musser, 1997). Organic farming risks were positively related to fixed cost sharing. Consultancy and fixed cost sharing were important responses to credit risks. The risk source consumer demand was positively associated with disease prevention, maybe related to increased consumer awareness of animal health problems that can be reduced through a healthier herd. Farmers who perceived human resource risks to be important appreciated financial risk management strategies.

5. Conclusions

Our results suggest that organic farmers perceived themselves to be less risk averse than their conventional colleagues. Both groups perceived institutional risks as primary sources of risk, with farm support payments top-rated. Conventional farmers perceived many sources of risk as more important than organic farmers, the difference being most pronounced for costs of purchased inputs and animal welfare policy. Organic farmers gave more weight to institutional factors related to their production systems (organic farming payments, price premiums, and organic regulations).

Financial measures, disease prevention, and insurance were perceived as the most important risk management strategies. Organic and conventional farmers' management responses were relative similar but organic farmers rated flexibility as more important. Both institutional and production risks were associated with multiple ways to handle risk.

A number of socio-economic variables had significant effects on risk perceptions and management responses. More significant variables were found for management responses than for risk perceptions. The low explanatory power in the regression models may imply a high degree of farm-specific risk perceptions.

The high support payments and high degree of regulation of agriculture in Norway obviously impact upon our results. Nevertheless, the agricultural policy system is not very different from what is found in several other Northern countries. This implies that similar results could be found in other countries, as indicated in Finland (Sonkkila, 2002).

The study revealed notable differences between organic and conventional dairy farmers' risk perceptions, suggesting that government policies may have to be applied differently to the two groups. Both groups of farmers were, however, worried about the institutional risks, indicating the importance of an agricultural policy that is clear, stable, and predictable. Policy makers should therefore be cautious about changing policy capriciously and they should consider the scope for strategic policy initiatives that give farmers some greater confidence about the longer term. One step in a more stable and predictable direction in Norway would be a change from annual to perennial agricultural negotiations between the farmers' unions and the government.

Risk research in agricultural economics and farm management has emphasised production and marketing risks (Musser and Patrick, 2002). Our findings suggest that more attention should be paid on studying institutional risks. Further, farm management consultants and advisers should make more use of decision analysis tools that incorporate institutional risks.

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Vedlegg 4

Herd health and health management in organic versus conventional dairy herds in Norway

Paul Steinar Valle[1], Ola Flaten[2], Gudbrand Lien[2], Martha Ebbesvik[3], and Matthias Koesling[3]

[1]The Norwegian School of Veterinary Science

[2]Norwegian Agricultural Economics Research Institute

[3]Norwegian Centre for Ecological Agriculture

Corresponding author: Paul.Valle@veths.no

Abstract

Earlier studies from Norway indicate that organic dairy farms enjoy better animal health than conventional dairy farms. However, these studies often use veterinary treatment data only, and may not reflect the health status of the farms, because health may be handled differently i.e. a different treatment scheme in organic versus in conventional farms. A study of animal health and health handling on both organic and conventional farms was performed based on information gathered from a mailed questionnaire. Responses from 159 and 149 conventional and organic dairy herds, respectively, were received and merged with herd health and production information from the Norwegian Cattle Health Services and the Norwegian Dairy Herd Recording System. Initially, there appeared to be many and large differences in herd health parameters between the two groups, however, after adjusting for differences in health handling i.e. a higher degree of self-induced non-medical disease handling as well as alternative medicine treatment, only a lower level of acute mastitis in organic dairy herds remained. When controlling for production level – milk yield being lower in organic herds – this difference also disappeared. Our results demonstrate the need for a critical assessment of health related data sources, i.e., to investigate how data have originated, and how they should be used adequately for research purposes.

Keywords: Organic; Dairy farming; Health; Management; Health records

1. Introduction

A major goal of organic livestock production is the enhancement of animal welfare and animal health, for example through prevention of disease (Alrøe et al., 2001; IFOAM, 2000). Studies of health and health handling on organic dairy farms are few, and those that have compared health performance on conventional and organic farms have produced conflicting results. In a literature review, Lund and Algers (2003) reported only 13 publications related to health in organic dairy production. Five of these were comparative studies of organic versus conventional dairy farms. Of these, two were carried out in Norway and two in Denmark. Lund and Algers (2003) conclude in their review that *'health and welfare in organic herds are the same as or better than in conventional herds'*. In some areas, however, such as parasite control and balanced ration formulations, there is a need for solutions that can "guarantee high levels of health and welfare" (Hovi et al., 2003; Sato et al., 2004). Hovi et al. (2003) state that there are "apparent conflicts" between environmental, public health and farmer income objectives in organic farming and animal health and welfare.

In one of the Norwegian studies referred to by (Lund and Algers, 2003), the most frequent health disorders (mastitis, ketosis and milk fever) were investigated and a better health performance was reported for organic dairy herds (Hardeng and Edge, 2001). Ebbesvik and Løes (1994) reach the same conclusion. In the two Danish studies (Vaarst et al., 1998; Vaarst and Bennedsgaard, 2001), however, no difference in health performance was reported. In the other Norwegian study referred to reproductive parameters were found to be impaired in organic dairy farms, which was associated with a deficit of nutritional energy during the winter season (Reksen et al., 1999).

Regarding animal welfare, von Borell and Sørensen (2004a) argue that "*high requirements for space allowance, for bedding and access to outdoor areas*" should open for a positive effect on animal welfare. However, the housing conditions and stockmanship in organic farming (Sundrum, 2001; Rushen, 2003) affect animal welfare and "*organic farming is consequently no guarantee for good animal welfare*" (von Borell and Sørensen, 2004b).

Hardeng and Edge (2001) used historical data from the Norwegian Cattle Health Service health card system, and one cannot exclude that systematic differences in health handling between organic and conventional dairy farmers were responsible for, at least in part, the reported difference in health performance as discussed by Bennedsgaard et al. (2003) and von Borell and Sørensen (2004b). The potential for systematic differences is related to an expected difference in health handling, related to more frequent use of alternative treatments such as homeopathy (Hovi and Rodrick, 2000; Henriksen, 2002). In Norway, individual dairy cattle health cards are completed by a veterinarian whenever animals are treated medically, and the routines are reported to be good (Valde, 2004). Health treatment such as homeopathic treatments, not involving a visit by a veterinarian, is therefore less likely to be reported into the system.

Comparing the two groups of dairy farms – organic versus conventional – as by Hardeng and Edge (2001) without taking into account potential for systematic differences in health handling and the consequences for the rate of health disorders reported may not tell the whole story, and can at worst produce misleading results. The aims of this study were: 1) to investigate for systematic differences in health handling between organic and conventional dairy farmers; 2) to use this information to adjust the health card record information and investigate for differences in the adjusted health information; and 3) to relate these findings to the animal welfare in organic versus conventional dairy herds.

2. Materials and methods

2.1. Questionnaire data

The data reported are a sub-set of a larger survey of risk and risk management in Norwegian farming (Flaten et al., 2005; Koesling et al., 2004). Both Norwegian crop and dairy farmers were sampled, although in this paper only data from dairy herds was investigated. Dairy herd size is small in Norway, and a dairy farm was defined as a farm with more than five dairy cows.

The 10-page questionnaire consisted of questions related to: 1) farmers' perceptions of risk, 2) farmers' perceptions of various risk management strategies, 3) farmers' goals, future plans and motivations for their farming system (organic or conventional), 4) animal disease management strategies, and 5) characteristics of the farm and farmer. Most questions were of the closed type, with many being in the form of seven-point Likert-type scales. The questionnaire was pre-tested on a sample of farmers, and refined several times, based on the comments and suggestions received.

The Norwegian Agricultural Authority (SLF) maintains a register of farmers who receive subsidies (i.e. all farmers), including farmers stocking an cropping details. Conventional dairy farmers were selected from this SLF-register for the year 2001, and, as part of a larger study, two groups of conventional dairy herds were selected – a simple random sample and a frequency matched sample that took into account the geographic distribution of organic dairy farms. The organic dairy herds selected were all registered herds supplying organic milk to TINE Norwegian Dairies BA. The questionnaire was first submitted in January 2003 to 616 conventional dairy farmers and 245 organic dairy farmers. A month later a reminder postcard was sent to all non-respondents. In March the questionnaire was again sent to farmers who had not responded.

Of the original 861 dairy farmers approached, 383 (62.2%) conventional and 161 (65.7%) organic farmers responded. After screening the data for misclassifications and highly incomplete questionnaires, the base consisted of 363 conventional and 162 organic dairy herds (the latter figure showing that some organic farms had been classified as conventional).

2.2. Health and production data

Information gathered from individual dairy cow health and production records at farm level are registered centrally by the Norwegian Cattle Health Services (http://storfehelse.tine.no/engelsk/) and the Norwegian Dairy Herd Recording

System. Some 97% of Norwegian dairy farmers participate in this recording system (Østeras, 2003). The health information is mainly related to veterinary visits and their medical treatments of animals at the farm. Norwegian farmers are not permitted to initiate medical treatments by themselves. A data set (2002-data) of the above database documenting individual health, reproduction and production information at the herd level, was merged with the questionnaire data. It appeared that 159 frequency-matched conventional dairy herds and 149 organic dairy herds had returned a completed questionnaire. The randomly sampled conventional herds were excluded, because we wanted to confine the comparison to herds receiving the same veterinary treatment strategies (i.e. the same veterinary practices).

2.3. Statistical analysis

A simple descriptive analysis was performed to compare the two groups with respect to key management, health, reproduction and animal welfare related variables. A simple two-sample *t*-test ($P<0.05$) was used for continuous variables and a chi-square-test ($P<0.05$) was used for categorical variables (ordinal Likert-type scale variables included).

The health card record information was adjusted based on the responses in the questionnaire, where farmers had responded to "how many out of ten" of selected health disorders "the veterinarians were called to". The data were then re-analysed using a simple two-sample *t*-test. The adjusted data were finally analysed using ordinary least square (OLS) regression models in order to control for potential effects of milk yield and average age distribution in the herd.

3. Results

The conventional and organic groups of dairy farms showed significant differences in key management variables such as milk yield, age distribution, percentage concentrate and percentage pasture of the total feed ration (Table 1). The share of the produced milk supplied to the dairy plant from organic dairy farms (86%) was significantly less ($P<0.05$) than for the conventional dairy farms (89%). The use of supplemental feed, e.g. hay, pasture and root crops, was more common in organic herds. (The basic feed in both groups was silage.)

With respect to the assessment of risk sources in terms of its potential impact on the economic performance of their farm, the two groups responded differently to the questions related to health and welfare. For example risk sources related to production diseases, domestic epidemic diseases and non-domestic epidemic diseases, as well as the impact of animal welfare policies, were all perceived least risky among organic farmers (Table 2).

In relation to statements comparing the two production systems, strong disagreements came up between the two groups. For example 81% of the organic farmers were disagreed with the statement that conventional livestock farming improves animal health, while only 19% of conventional farmers were disagreed with the same statement. Some 72% of the organic farmers strongly agreed with the statement that organic farming better maintains an animal's requirements, while only 10% of the conventional farmers supported the same statement. Organic farmers were less in agreement with the statement that a stressed economy would harm animal welfare and health. The two groups of farmers were more agreed on the importance of risk management in preventing/reducing livestock diseases. Organic farmers relied less on veterinary advice in coping with risk.

Table 1 Key management variables in milk production for conventional dairy herds which were frequency matched with organic dairy herds

	Conventional(n=159)		Organic (n=149)		
	Mean	Sd	Mean	Sd	
Number of dairy cow-years[1)]	15.17	6.75	16.32	9.95	
Age of dairy cows (in years)	4.14	0.55	4.46	0.61	*
Milk yield (kg) per cow years	6110	1092	5081	1019	*
Milk supplied (L) per cow years	5408	1012	4388	976	*
Total feed units[2)] per cow year	4397	1141	3905	1124	*
Percentage silage	38.6	14.5	39.3	16.2	
Percentage concentrate	39.3	20.07	27.44	22.49	*
Percentage hay	1.5	3.65	3.79	8.07	*
Percentage pasture	16.6	10.69	26.11	12.24	*
Percentage root crops	0.11	0.73	0.35	1.35	*
Percentage potatoes	0.25	1.48	0.26	0.89	
Percentage other feed	0.15	1.07	0.38	1.61	

Variables marked with an asterisk show that the mean scores of conventional and organic farmers are significantly different according to a two-sample *t*-test (*$P<0.05$).

1) Cow-years equal the number of feeding days from the 1st calving or 1st of January to culling for all specified cattle in a given year, divided by 365 days .
2) One feed unit milk (FUm) is defined as 6900 kJ of net energy lactation (Ekern, 1991).

When investigating the key health and reproduction related variables from the Norwegian Cattle Health Services, the two groups differed for most of the variables (Table 3). The treatment frequency for all diseases in organic farms was only 60% of that of conventional farms, with mastitis treatment contributing most of the difference. Milk fever, vulvovaginitis and heat synchronisation were the exception with no difference. No difference in calving interval – an indicator for reproductive performance – was observed. (It should, be noted that calving interval is an imprecise indicator since it is affected by the culling pattern within the herd.)

Attitude to disease handling also differed in the two groups (Table 4). Organic farmers applied more self-induced and supplementary handling (e.g. frequent milking) as well as alternative treatments in respect of mastitis cases. Some 55% of organic farmers used alternative treatments 'sometimes' or 'often' compared to only 14% among conventional farmers. Organic farmers also had a more frequent use of other feed supplements with respect to treatment of ketosis. Organic farmers reported that they less often make use of the dairies feeding advisory services.

Table 2 Risk-related responses associated with animal health and welfare from the questionnaire where the two groups – conventional (C) and organic (O) dairy farmers – significantly differ ($P<0.05$; χ^2-test for categorical data). Percentages of responses in the different groups are reported.

		Group[1)]		
		I	II	III
Sources of risk				
Production diseases	C/O	16/31	59/57	25/12
Domestic epidemic animal diseases	C/O	9/26	39/45	52/29
Non-domestic epidemic animal diseases	C/O	13/33	19/22	68/45
Animal welfare policy	C/O	11/32	25/34	64/34
Agreement with statement				
Conventional livestock farming improves animal health	C/O	19/80	45/17	36/3
Organic livestock farming increases the risk of underfeeeding and malnutrition	C/O	26/59	37/36	37/5
Organic farming better maintains animals' natural requirements	C/O	40/6	50/22	10/72
Stressed economy harm animal welfare and health	C/O	17/30	33/41	50/29
Risk mangement strategies				
Use of veterinary advisory services	C/O	10/22	37/50	53/28
Prevent/reduce livestock diseases	C/O	2/0	10/19	88/81

1) Likert-type scale response originally ranging from 1 to 7 pooled for the tabulating purpose, into 3 groups by merging 1 and 2 into group I, the responses in 3, 4 and 5 into group II and the responses in 6 and 7 into group III

There was no indication of difference in the farmers, reporting of their own health handling into the Norwegian Cattle Health Recording Services. As a general observation, both group of farmers responded that their own health management/treatment (if applying such measures) is not 'often' reported, e.g., only about 6% 'often' make a note when carrying out frequent milking and only 26% when carrying out an alternative treatment (Table 4).

In the questionnaire the farmers were asked to respond to 'How many out of ten cases of the listed diseases are you calling the veterinarian to?' Cases were defined by objective measures such as fever for "acute mastitis" and positive Schalm reaction without fever for "mild mastitis". With the exception of milk fever, organic farmers reported that they called the veterinarian less frequently compared to the conventional dairy farmers (Table 5). Conventional farmers reported, e.g., that they called the veterinarian to 4.5 out of ten mild mastitis cases, while organic farmers only called the veterinarian to two out of ten.

Table 3 Key health- and reproduction-related variables from the dairy cattle health record system for conventional and organic dairy farms

	Conventional (n=159)		Organic (n=149)		
	Mean	Sd	Mean	Sd	
Geometric somatic cell count	117.7	48.3	126.4	49.5	
Calving interval	389.9	40.0	387.7	31.6	
Culling rate	43.0	25.9	36.6	23.3	*
Replacement rate	42.6	21.5	38	18.7	*
Treatment (Tr.) for all diseases	72.1	62.6	44.2	51.5	*
Tr. For all mastitis cases	30.7	27.0	17.7	24.8	*
Tr. For acute mastitis	19.5	19	11.7	17.6	*
Tr. for clinical (cl.) mastitis	30.2	26.7	17.5	24.2	*
Tr. for sub-cl./chronical mastitis	11	14.6	5.9	13.2	*
Tr. for teat tramp	2.9	6.2	1.3	4.1	*
Tr. for milk fever	5.4	9.9	4.8	7.8	
Tr. for ketosis	6.3	11.9	3.4	8.4	*
Tr. for indigestions	1.4	5.5	0.4	1.8	*
Tr. for retained placenta	2.8	5.8	1.8	3.6	*
Tr. for vulvovaginitis	0.7	4.1	0.6	2.7	
Tr. for lack of heat	2.4	7.3	0.6	3.2	*
Tr. for heat syncronisation	0.4	2.1	0.2	1.9	
Tr. for ovarian cysts	1.2	3	0.3	1.6	*

* significantly different according to a two-sample *t*-test ($P<0.05$).

Adjusting the key health variables reported to the recording system for differences in frequency of calling the veterinarian produces a more accurate estimate of disease frequency. Subsequent investigations for differences in health performance, using a simple two-sample *t*-test, now indicates a difference in the incidence of acute mastitis only (Table 6). When testing for health performance while controlling for average milk production and age in the herds (using an OLS regression model) all differences in health performance, including acute mastitis, disappeared (Table 7).

Table 4 Frequency statistics for disease handling variables from questionnaire data collected from conventional (C) and organic (O) dairy farms

		Never	Some times	Often	
Milking of mastitis cow treated by a veterinarian	C/O	7/10	55/50	38/40	
Milking of mastitis cow not treated	C/O	31/19	47/45	22/36	*
Use of heat liniments	C/O	49/33	35/46	16/21	*
Alternative treatments (any disease)	C/O	86/45	8/30	6/25	*
SCC cows with suckling calves	C/O	76/46	17/31	7/23	*
Drying off without treatment	C/O	51/35	42/54	7/11	*
Drying off after treatment	C/O	9/12	77/80	14/8	
Separate milking	C/O	25/22	25/26	50/52	
Culling without treatment	C/O	30/36	65/56	5/8	
Use of feeding supplements to ketosis cases	C/O	22/44	45/31	33/25	*
More than two daily feedings of concentrate	C/O	20/44	21/19	59/37	*
Other feed stuff supplements	C/O	23/9	38/37	39/54	*
Use of body scoring	C/O	15/13	45/51	40/36	
Use of feeding advice services	C/O	6/25	24/35	70/40	
Use of Ca supplements to milkfever (mf) cases	C/O	48/56	35/32	17/12	
Use of body scoring for mf prevention	C/O	17/18	52/51	31/31	
Use of feeding advice services	C/O	9/29	28/37	63/34	*
Notes[1)] of self induced health handling[2)]	C/O	81/73	15/20	4/7	
Notes of self induced alternative treatments[2)]	C/O	53/38	26/33	2129	

* significantly different according to a chi-square test ($P<0.05$).

1) The farmer making notes in the Norwegian Cattle Health Services System.

2) Responses among the farmers reporting to apply this health handling.

Table 5 Conventional and organic farmers' response to the question 'How many out of 10 cases of the listed diseases are you calling the veterinarian?'

	Conventional (n=154)		Organic (n=136)		
	Mean	Sd	Mean	Sd	
Acute mastitis	9.59	1.38	8.17	3.13	*
Mild mastitis	4.48	3.69	2.07	2.93	*
Chronic mastitis reported in NCHS[1)]	3.52	3.61	1.37	2.38	*
Mastitis in heifers	7.99	2.99	4.79	3.95	*
Ketosis	7.66	3.43	6.06	4.09	*
Milkfever	9.65	1.74	9.26	2.34	

* significantly different according to a two-sample t-test ($P<0.05$).

1) Norwegian Cattle Health Services.

Table 6 Key health variables in conventional and organic herds from the dairy cattle health record system adjusted for the frequency of calling the veterinarian to health disorders, see table 4

	Conventional(n=159)		Organic (n=136)		
	Mean	Sd	Mean	Sd	
Acute mastitis	22	23.6	15.3	23.7	*
Mild mastitis	125.3	195.8	108.3	181.7	
Chronic mastitis reported in NCHS[1)]	51.5	91.6	43.1	113.6	
Ketosis	9.8	20.8	8.7	20.8	
Milkfever	6.0	11.5	5.8	10.2	

* significantly different according to a two-sample *t*-test ($P<0.05$).

1) Norwegian Cattle Health Services.

Table 7 Results of OLS regression models (coefficients with standard error in brackets) for adjusted health variables, Table 5, versus the farming system effect and control variables

	Response variables				
Explanatory variables	Acute mastitis	Mild mastitis	Chronic mastitis	Ketosis	Milk fever
Farming system[1)]	-2.2	19	-0.9	-2.8	0.7
	(3.1)	(25)	(13)	(3.0)	(1.4)
Milk yield	0.004*	0.02*	0	-0.001	0.002*
	(0.001)	(0.01)	(0.01)	(0.001)	(0.001)
Average age of dairy cows	-0.0008	-0.08	-0.07*	-0.01	0.01*
	(0.007)	(0.06)	(0.03)	(0.01)	(0.003)
Model R^2	0.048	0.039	0.017	0.004	0.05

Variables and models are significant at $*P<0.05$.

1) Measured as a dummy variable where 1 denotes organic farming and 0 denotes conventional farming.

4. Discussion

Because of the random sampling within the limitations of the frequency matching of conventional dairy farms to organic farms, and the relatively high response rate, the samples are assumed to accurately represent both the conventional and organic dairy farmer populations, given the spatial distribution of organic dairy herds.

4.1. General remarks to the dairy production in the two groups

The investigation confirms what Hardeng and Edge (2001) have reported earlier with respect to a lower milk yield in organic compared to conventional dairy herds in Norway (Nicholas et al., 2004). This finding is likely associated with the feeding regime and in particular a lower level of concentrates used in the organic feeding ration. However, it may also be a goal of organic farmers to limit the milk yield of their dairy cows. The data also indicate that organic farms use a larger range of different feeds.

Since there is less use of antibiotic treatments in organic herds, one could expect a higher percentage of the produced milk to be supplied to the dairy plant, but both a longer period of calf feeding with cow milk (at least 12 weeks) as well as a longer withdrawal period after antibiotic treatments (doubling the legislated withdrawal period), negate this expected result.

4.2. Perception of the risks related to health and welfare in dairy production

We observed that organic farmers were less concerned than conventional farmers about potential health threats both from domestic (endemic) and non-domestic (exotic) diseases. In addition, potential changes in animal welfare policies, which were much discussed in Norway at the time of the questionnaire survey, were perceived as a less important source of risk among organic farmers. This finding may be related to organic farmers more strongly believing that they have better systems for herd health, and that they are better protected from risky contacts (with respect to animal health) through their farming systems. The rule in organic farming is self-recruitment or recruitment of approved organic animals, which might reduce both the perceived risk as well as the actual risk. Further, and with respect to animal welfare, they may believe that the Norwegian organic animal welfare regulations are stricter than the new general minimum standards (Flaten et al., 2005).

4.3. Health handling

Organic farmers appears to be more active in the handling of the health disorders themselves, for example, by applying extra milking and application of heat liniments on animals showing signs of mastitis. They feel less in need of veterinary advisory services, and they use alternative treatments (not involving the veterinarian) to a much larger extent than conventional farmers. In a recent study in Norwegian dairy herds, alternative treatments were found to lack a direct healing effect on mastitis (Hektoen et al., 2004), but due both to the self-healing process and the actual effect of the supplementary handling measures, fewer health disorders are likely to reach the stage where a veterinarian is required. The organic farmers calling the veterinarian to fewer of the observed cases at the farm support this statement.

Only a small percentage of both organic and conventional farmers self initiated treatments were incorporated into health card records and therefore, the Norwegian Cattle Health Services database. This database contains, therefore, information primarily derived from visits by veterinarians most often involving medical treatment. Hence, this study confirms that one needs to have more than veterinary treatment records when assessing herd health status on a farm.

4.4. Health performance

The apparent differences in herd health performance between organic and conventional farms, based on the health service database, disappear when the questionnaire data are incorporated, with exception of acute mastitis.

Genetic studies indicate a positive association between milk yield and mastitis frequency (Emanuelson, 1988; Pryce, et al., 1998). Hence, a lower production level may be enough to explain the observed lower mastitis frequency in organic dairy herds. This explanation is supported by the difference in frequency of acute mastitis disappearing when controlled for milk yield in the regression model comparing the two groups. Altogether the ”true” health performance in organic dairy farming seems to be no different from that in conventional dairy herds when taking into account the effect of a different production levels. This is in contrast to what was reported by Hardeng and Edge (2001), but in agreement with the findings from Denmark (Vaarst et al., 1998; Vaarst and Bennedsgaard, 2001). According to The European organic livestock regulations (EC, 1999) and production standards there should be focus on animal health including breeding for disease resistance. The current data do not support a breeding effect beyond that in conventional dairy herds in Norway. Also, due to the higher usage of pasture one might expect a positive health effect (Regula et al., 2004), however, this was not observed.

Following adjustments for production level, there is no difference in health performance between the two groups, however, the absolute health situation on organic farms is better than on conventional farms. This finding is based on the fewer cases of acute mastitis, most likely due to the lower production and associated less stress of the udder. Padel (2002) reported that animal health problems was a key issue for conventional farmers to convert to organic production methods, and also organic farmers participating in this study tend to believe that their animal health status is equal or better than in conventional herds, judged by the strong disagreement with the statement “Conventional livestock farming improves animal health”.

Health is, as stated earlier, a relative term, which may be assessed on a continuous scale. Whether organic farmers had the same assessment or criteria for what falls within, e.g., acute mastitis and mild mastitis is not investigated and might of course distort the findings in this study. However, the questions were phrased to include objective measurements such as ‘fever’ for acute mastitis and ‘a positive Schalm test’ for mild mastitis, and we believe this at least will reduce the likelihood of misunderstanding and invalid information among the respondents.

The study showed that veterinary treatment data do not represent the actual health situation in a herd. However, we do not believe that our method have given us the true disease status, but we do believe that the applied method has removed some of the differences due to disease handling and make a comparison between the two groups of dairy herds more valid.

4.5. Animal welfare

A lower frequency of mastitis will have a positive effect on the welfare of the dairy cattle since mastitis puts the animals into a state of pain and/or distress. In addition, the increased level of farmer involvement in the treatment of their animals supports the argument that animal suffering receives a higher degree of attention and care in organic farms. On the other hand, one could argue that a course of action other than calling the veterinarian for diagnosis and medical treatment could prolong suffering and/or distress for the animals. Would, for example, the use of alternative treatments such as homeopathy, increase the risk of under-treatment and related distress (von Borell and Sørensen, 2004a), compared to a "classical" veterinary treatment with antibiotics and pain relievers? In a Danish study (Vaarst et al., 2001) did not find that clinical cases were not treated, however, in the present study we did observe that the veterinarian was called to fewer cases than observed by the farmers – mostly for the mild cases. This was also observed for conventional farms, but to a less degree.

A question asking whether the health management at the studied organic herds lead them to a better or a worse "place to be" for cows with respect animal welfare, could not be determined from the current data. It is, however, reason to claim that because the organic farmers take a greater responsibility for the health handling themselves, they ought to be at least as competent as conventional farmers in this respect.

Many aspects come into the assessment of animal welfare. According to Lund (2000) there is a conflict between the concept of "naturalness" and systems thinking on the one hand and the individual animal welfare on the other hand. The more frequent use of pasture by organic farmers allows animals' access to a more natural life, and arguably improved animal welfare. But pasture may cause distress of the single animal if improperly managed, for example by promoting a major parasite burden as has been reported for organic farming elsewhere (Hovi et al., 2003; Sato et al., 2004). Parasitic load was not available from the data set, nor was weight gain in young stock, which could be used as an indicator of parasite problems. Therefore, it was not possible to evaluate animal welfare considerations associated with a more natural life style.

Nicholas et al. (2004) argues that if consumers are made aware of the high value placed on animal welfare in organic farming systems and this becomes a greater incentive for them to purchase organic products, quantifying and improving animal welfare would benefit the industry. However, further research is required (Nicholas et al., 2004).

5. Conclusion

The present study support a difference in health performance between organic and conventional dairy herds, but only for acute mastitis which is most likely explained by the lower production level (milk yield) on organic dairy farms. The lower level of mastitis, together with a higher usage of pasture use, supports the idea of better welfare in organic dairy production (without saying that there is a low animal welfare level in conventional farming). However, due to a higher level of self-treatment without insight into the potential consequences of this management strategy, and also an unknown parasite burden at pastures, the current data could not support any firm conclusion regarding the well being of animals in organic versus conventional dairy farms.

However, the study does show that not all health disorders occurring at a dairy farm are reported to the Norwegian Cattle Health Services system. Systematic differences in health handling between the two groups studied – organic and conventional – is present, and make it necessary to collect additional information in order to arrive at a valid analysis and interpretation of the "true" health performance. This finding stresses the need for a critical assessment of health-related data sources with a view to how the data have originate, and how they can be adequately used and supplemented for research purposes.

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Vedlegg 5

Do the new organic producers differ from the "old guard"? Empirical results from Norwegian dairy farming*

Ola Flaten, Gudbrand Lien, Martha Ebbesvik, Matthias Koesling, and Paul Steinar Valle

Abstract

Conventional farmers converting to organics has contributed to most of the rapid expansion of organic farming in recent years. The new organic farmers may differ from their more established colleagues, which may have implications for the development of the organic farming sector and its distinctiveness vis-à-vis conventional production and marketing practices. The aim of this study was to explore Norwegian organic dairy farmers' personal and farm production characteristics, farming goals, conversion motives, and attitudes to organic farming, grouped by year of conversion (three groups). A postal survey was undertaken among organic dairy farmers. The results show that the newcomers (converted in 2000 or later) were less educated than the early entrants (the so-called "old guard") who converted in 1995 or earlier. The frequency of activities like vegetable growing and poultry farming among the old guard was high. The late-entry organic herds were fed more concentrates and had a higher milk production intensity, showed a higher incidence of veterinary treatments and less frequent use of alternative medicine than the herds of the two earlier converting groups. For all groups of farmers, the highest ranked farming goals were sustainable and environment-friendly farming and the production of high quality food. Late entrants more often mentioned goals related to profit and leisure time. On average, the most frequently mentioned motives for conversion were food quality and professional challenges. The old guard was more strongly motivated by food quality and soil fertility/pollution issues than the others, whereas financial reasons (organic payments included) were relatively more important among the newcomers. All groups held very favorable views about the environmental qualities of organic farming methods, albeit with different strengths of beliefs. Even though trends towards more pragmatic and business oriented farming were found, the majority of the newcomers were fairly committed.

Key words: organic farming, milk production, year of conversion, farming goals, motives for conversion, attitudes, animal health, feeding, conventionalization

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Introduction

Organic farmers have been critical of mainstream conventional agriculture, its industrialization and the productivity paradigm. The organic pioneers' idea was to develop the farm as a system that makes use of its own resources as far as possible and only draws on external resources when necessary and appropriate[1]. Today, organic farming has a wide range of sustainability and environmental objectives. The organic movement, originally consisting of a small number of "particularly committed" farmers and consumers, established alternative, grass roots oriented production and distribution systems.

Organic farming has become more popular, as consumer demand has increased. Currently more than 26 million ha are farmed organically worldwide[2]. Of this figure, 11.3 million ha are in Australia, mostly extensive grazing land. In the USA, 0.93 million ha are managed organically, representing 0.22% of the farmland. The percentage of organically farmed land is highest in Europe (more than 2% of the farmland). In Europe, almost 6.3 million ha are managed organically by almost 170,000 farmers. Since the early 1990s, the growth in Europe has been associated with public support for organic farming[3,4]. After years of rapid organic food sales growth, the market is now maturing in many European countries.

Along with organic farming's popularity, some researchers have warned that the organic movement may be in danger of loosing its identity, with agribusiness involvement and abandoning of the more sustainable agronomic and marketing practices originally associated with organic agriculture[5,6,7]. For example in California, allowance of "natural" inputs, like sulfur dust to control fungus, have facilitated organic production of specific crops like grapes[7]. This argument has been canonized as the "conventionalization thesis". Others describe organic agriculture as a useful and complex example of the way in which nature features in contemporary food production and consumption[8,9]. Besides, it is apparently impossible to disentangle the organic food production from the organic social movement[3,10].

Some studies have examined characteristics, motives and attitudes of organic farmers, and how the conversion year impacts the variables. An early study classified Norwegian organic farmers into two main groups[11]. The first group, the pioneers, of cosmopolitan organic farmers had a strong ideological foundation based on ideas from anthroposophy or eco-philosophy. The second group was locally oriented farmers who wanted to farm environment-friendly, but their ideological orientation was less pronounced.

A literature review[12] concluded that motives for conversion appeared to have changed from the earlier philosophical ideals and husbandry and technical reasons towards an increasing focus on environmental and economic concerns, and the perception of organic farming as a professional challenge. The importance of subsidies for farmers' decisions to convert has not been studied in detail[13]. There has been little direct research about the goals of organic farmers[12]. Several studies of organic farmers have looked at personal and social characteristics, such as farm size, farming background and education, and the farmers' attitudes (reviewed in Padel[12]), but little is known about, for example, gender issues. Moreover, few studies have carried out a rigorous comparison of farm and personal characteristics of the early entrants (the "old guard") versus the new (late-entry) organic producers[12].

This exploratory study aims to fill parts of these gaps by providing empirical information about Norwegian organic farmers' personal and farm characteristics, farming goals, motives for conversion, and attitudes to organic farming, grouped by year of conversion. The study is restricted to dairy farming because it is the dominant form of organic livestock production in Norway. In addition, comprehensive farm level data regarding production records and animal health management are available.

Organic Farming in Norway

Organic farming in Norway started in the early 1930s, but until the 1970s there were just a few organic farms in the country. Most of the pioneers followed Rudolf Steiner's biodynamic farming principles. Nowadays fewer than 30 Norwegian farmers follow these principles.

An organic farmers' organization was first established in 1971. In 1986, the certification and inspection organization *Debio* was founded. Debio certifies all organic production methods. Debio also implements the official national standards for organic farming. The Norwegian legislation is subject to the EU regulations for organic plant production from 1991 (EC Regulation No 2092/91) and supplemented by common standards for organic animal husbandry from 1999 (EC Regulation No 1804/1999).

Since the 1990s, public initiatives encouraged farmers to convert to organic production. Conversion grants and support schemes for organic farmland were introduced in 1990. A scheme enabling farmers to apply for free organic milk quotas was launched in 1995, and area payments, particularly for organic grain, gradually increased. Organic livestock payments were established in 2001. The food industry introduced organic premiums on several products, milk and beef included, in 1996.

The number of organic farms increased from 423 in 1991 to 2484 in 2004[14]. In the same period, the area of organically certified farmland and land in conversion increased from 2443 ha to 41,036 ha. In 2004, the organic area and land in conversion amounted to 4.0% of the total farmland. Organic milk production increased from 3.6 million liters in 1997 to 24.3 million liters in 2004. A total of 1.6% of all milk produced in 2004 was organic[15].

One of the Ministry of Agriculture's prevailing aims is to achieve ten percent organically managed area by 2009[16]. Organic farming methods are said to contribute to food safety, greater product diversity, environmental benefits, sustainability, enhanced farm incomes and reduced food surpluses. The land area target must however coincide with adequate development of the organic markets. The share of organic milk reaching consumers as organically labeled products was only 25% in 2004[15], i.e., 75% of organically produced milk was going into conventional dairy products. The Norwegian dairy cooperative TINE, the main purchaser of milk from farmers, guarantees organic farmers in the main organic dairy areas a price premium of NOK 0.60 per liter milk ($ 1 ≈ NOK 6.40) until the end of 2005. Supply chain and marketing issues have to be seriously addressed to mitigate the organic milk supply-demand imbalance and its resulting downward pressure on farm-gate prices in the years to come. One recent effort by TINE, expected to double the sale of organic milk products, is to make kefir-fermented milk only from organic milk.

Generally, climatic and topographical conditions contribute to high costs of agricultural production in Norway and farm support is consequently high. Agricultural policies have encouraged agriculture's multifunctionality and contribution of public goods to society, e.g., rural viability, landscape preservation, food security and cultural heritage[17]. Farm support programs have accordingly favored small family farms. Problems related to food safety and environmental issues have been few. The potential market for organic food will, therefore, have better conditions in other high-income countries with a higher degree of industrialized agriculture and/or problems with food-borne diseases than in Norway[18]. Another challenge for the development of organic farming in Norway is the small population of 4.6 million, which is spread over a wide area.

Materials and Methods

Data and sample

Data from organic dairy farmers examined in this paper were collected as part of a larger questionnaire survey among Norwegian farmers[19,20]. Data (2002) from the Norwegian Agricultural Authority (SLF), the Norwegian Dairy Herd Recording System and the Norwegian Cattle Health Services were merged with the questionnaire data.

The questionnaire was first sent out in January 2003 to all 245 registered producers of organic milk. Some 161 (65.7%) farmers responded, of which 92% participated in the Norwegian Dairy Herd Recording System and the Cattle Health Services.

Questionnaire design

The questionnaire presented farmers with questions related to: (1) farm and farmer characteristics; (2) farmers' goals and motives for their farming system; (3) a series of statements designed to test their attitudes with regard to characteristics of organic farming compared to conventional farming; (4) livestock disease management strategies, included their use of alternative veterinary medicine (homeopathy, acupuncture, herbal medicines, etc.); and (5) farmers' risk perceptions and management responses.

Farmers were asked to report the year in which the farm's first field(s) was certified as organic farmland. This year was presupposed to be the year of conversion to organic farming.

From a list of 14 (10) farming goals (motives for conversion), the respondents were asked to select up to five goals (three motives) as most important for them. Goals and motives were treated as categorical binary data: "important" if the goal (motive) was rated among the five (three) most important, and ”less important” otherwise.

Respondents’ attitudes were examined by means of a series of statements. Farmers were asked to score each attitudinal question on a seven point Likert-type scale. The Likert-type scales were considered as metric variables.

Statistical analyses

The respondents were categorized into three groups, representing the year of conversion to organic farming: (1) those who had farmed organically since 1995 or earlier (*early converters*, i.e., the “old guard”); (2) those who were certified in the years 1996 to 1999 (*mid converters*); and (3) those who started farming organically in 2000 or later (*late converters*, i.e., the new producers). The categorization was based on several concerns: phases in the development of the organic farming sector in Norway; avoidance of insensitiveness of statistical tests due to small sample sizes, and finally; subjective judgments.

Mean values obtained in different groups for metric variables were compared by *t*-tests. Chi-square statistics were generated for comparisons of frequencies of categorical data.

Results and Discussion

Key respondent characteristics

Personal characteristics of the three groups are shown in Table 1. The mean scores in the groups and the total mean are reported along with the results of the significance tests.

The average organic dairy farmer was 47 years old and had 23 years of farm experience. Late entrants were significantly younger and had less farming experience than the two earlier groups.

Female farm owners comprised just 14% of the farms. Storstad and Bjørkhaug[18] sampled from all organic farmers in Norway and found a higher share of female organic farmers (20%). Replies to the question on farm management responsibility also indicated few females. The early entrants had a higher portion of farms with divided responsibility between persons, suggesting that females on these farms were more involved in the farm decision-making. At the same time, females on early converting farms were less involved in off-farm work than in the later groups. More than 40% of the respondents had some college or university education, quite similar to the 34% observed among all Norwegian organic farmers[18]. Early entrants had a significantly higher educational level than the late entrants.

Farm production

Farm production practices for the three groups are shown in Table 2. The mean scores in the groups and total mean are reported along with the results of the significance tests.

A greater number of the old guard farmers, compared to the mid and late entrants, cultivated ”other crops” and kept poultry, however, usually on a very small scale. They also tended to more mixed livestock farming than the later groups. These findings indicate that a substantial part of the old guard follow the organic ideals and traditions of mixed farming and farm household self-sufficiency. These strategies are evidently less common among later entrants and may influence the sustainability of the organic farming practices.

Table 1 Mean characteristics of farmers grouped by year of conversion

Characteristic	Early conv. (1)	Mid conv. (2)	Late conv. (3)	All	Significant difference[1]
Number of respondents	45	68	48	161	
Age of farmer[2]	50.5	48.4	42.8	47.2	**1-3, 2-3**
Farming experience (years)	23.3	24.9	18.7	22.6	1-3, **2-3**
Years since conversion (2003 reference)	12.6	5.4	1.8	6.3	**1-2, 1-3, 2-3**
Farmer's age at conversion[2]	39.1	43.0	41.0	41.4	1-2
Marital status (% married farmers)	97.6	89.6	95.8	93.6	
Family farm (% of farms)	88.6	93.9	93.8	92.4	
Gender (% female owners, family farms)	13.2	11.3	17.0	13.8	
Farm management responsibility (%)[3]	5/49/46	7/65/28	10/63/27	8/60/32	**1-2, 1-3**
Off-farm work (% of farms)[4]	62.2	76.5	70.8	70.8	
Off-farm work (% of farm wives)	55.3	74.6	71.1	67.9	1-2
Univ./college education (% of farmers)	53.7	38.2	31.3	40.1	1-3
Agricultural education (% of farmers)	82.5	77.9	68.1	76.1	
Farm income (% of farmers)[5]	46.3	43.3	52.1	46.8	
Household income (% of farmers)[5]	43.9	50.8	55.3	50.3	
Location (% of farmers)[6]	46.7	39.7	37.5	41.0	

"Early converters" = conversion in 1995 or earlier, "Mid converters" = 1996-1999, "Late converters" = 2000 or later.

1) Significant differences are in italics ($P<0.10$), normal ($P<0.05$) or bold ($P<0.01$), based on *t*-tests for metric variables and chi-square tests for categorical variables.
2) Data from SLF (the Norwegian Agricultural Authority), age only of family farm owners.
3) Principal person(s) in charge of farm management: Woman/man/split between two or more persons.
4) Percentage of farms where the farmer and/or the spouse had some off-farm work.
5) Percentage of farms with farm income (household income) higher than NOK (Norwegian kroner) 200,000 (NOK 350,000).
6) Percentage of farms located close to urban areas (with no regional policy priority).

Supply of concentrates per cow was quite similar between the two earliest groups, while the new producers' cows were fed more concentrate. The higher concentrate feeding intensity was associated with a higher milk yield per cow. Lower milk production per cow in old organic herds was also found in a Danish study[21]. The late entrants' average milk yield of 5398 kg per cow was low compared to the overall average of 6190 kg in Norwegian dairy herds[22]. Further, only 11% of the organic herds exceeded 6500 kg per cow in milk yield. Of these, 56% were in the late-entry group. On the other side, 15% of the herds achieved less than 4000 kg milk per cow, in part due to the use of indigenous cattle breeds. The greater part of the farms thus had a low to moderate milk production intensity. The findings do not suggest widespread "intensification" of milk production.

Late entrants replaced more heifers than early entrants. Culling rates were more similar among the groups. A German study also found less intensive replacement and culling policies in older organic herds[23].

Table 2 Mean values of farm production practices grouped by year of conversion

Characteristic	Early conv. (1)	Mid conv. (2)	Late conv. (3)	All	Significant difference[1]
Labor					
Farm labor units (man-years)	2.19	2.06	2.19	2.13	
Land management					
Farmland (ha)[2]	29.2	28.9	33.0	30.2	
Grassland (ha)[2]	24.5	25.3	28.2	25.9	
Grain (ha)[2]	4.0	3.4	4.3	3.8	
Grain (% of farms)[2]	53.3	35.3	47.9	44.1	*1-2*
Other crops (% of farms)[2,3]	55.6	22.1	22.9	31.7	**1-2, 1-3**
Stocking rate (LU ha UAA^{-1})[2,4]	1.24	1.10	1.18	1.16	
Livestock management					
Number of dairy cows[2]	16.6	16.4	17.4	16.7	
Number of young cattle[2]	23.6	22.9	28.2	24.6	*2-3*
Milk yield per cow (kg $year^{-1}$)[5]	4830	5073	5398	5110	1-3
Concentrates (FUm cow^{-1})[5,6]	819	836	1006	885	1-3, 2-3
Heifer replacement (% of cows)[5]	33.9	36.3	41.0	37.1	*1-3*
Culling rate (% of cows)[5]	35.6	34.0	38.1	35.7	
Other mammals (% of farms)[2,7]	51.1	36.8	33.3	39.8	*1-3*
Poultry (% of farms)[2,8]	40.0	13.2	12.5	20.5	**1-2, 1-3**
Animal health					
No. of disease treatments/100 cows[5]	32.7	39.4	53.0	41.9	*1-3*
Use of alternative medicine (% of farmers)	77.5	66.7	43.5	62.5	**1-3**, 2-3

1) Significant differences are in italics ($P<0.10$), normal ($P<0.05$) or bold ($P<0.01$), based on *t*-tests for metric variables and chi-square tests for categorical variables.
2) Data from SLF.
3) Percentage of farmers having 0.2 ha or more of potatoes, vegetables, fruit or berries.
4) Livestock units (LU) per ha utilizable agricultural area (UAA). Figures based on number of livestock and hectares from the Norwegian Agricultural Authority, and LU-numbers in Debio14.
5) Data from the Norwegian Herd Recording System and the Norwegian Cattle Health Services.
6) One feed unit milk (FUm) is defined as 6900 kJ of net energy lactation.
7) Farms having at least two other animals (suckler cows, sheep, goats, pigs, horses).
8) Farms having hens, chicken, turkeys, ducks or geese.

The late organic herds showed the highest level of registered disease treatments per cow, mainly related to veterinary visits and medical treatments. Similar trends were found for mastitis treatment in Denmark[21]. A vital question is however if the registered disease treatments actually mirror the true number of diseases in the herd. The farmer's threshold for veterinary treatment of diseases, *inter alia* influenced by the degree of self-initiated non-medical disease handling, affects the resulting treatment rate. Further, alternative treatments are seldom reported to the Cattle Health Services, and the earliest groups had a significantly higher user frequency of alternative medicine. The use of alternative medicine and treatment methods is recommended by organic farming standards, but almost 40% of the farmers never used it.

To summarize, the findings suggest differences in agronomic and husbandry practices between the groups. Since the late entrants had converted recently, a question of how much the long-term effects of organic farm management practices really had shown-up in these herds may be raised.

Farmers' goals

Table 3 shows the percentage of farmers in the groups rating various farm goals as important, and whether the ratings by the groups differed significantly.

Table 3 Farmers' goals grouped by year of conversion

Goal	Early conv. (1)	Mid conv. (2)	Late conv. (3)	All	Significant difference[1]
Sustainable and environment-friendly farming	88.9	83.8	68.8	80.8	1-3, *2-3*
Producing high quality food	80.0	77.9	75.0	77.6	
Reliable and stable income	51.1	60.3	58.3	57.1	
Time for family, living quality for children	62.2	50.0	54.2	54.7	
Independency, self employment	46.7	47.1	37.5	44.1	
Work with animals/crops	40.0	30.9	39.6	36.9	
Improve the farm for the next generation	28.9	44.1	27.1	34.8	*2-3*
Have sufficient leisure time	17.8	17.7	37.5	23.6	1-3, 2-3
Reduce debt, become free of debt	13.3	23.5	27.1	21.7	
Continue to be a farmer	13.3	19.1	25.0	19.3	
Maximize profit	6.7	10.3	22.9	13.0	1-3, *2-3*
Social contacts	11.1	8.8	4.2	8.1	
Increase equity	6.7	0.0	2.1	2.5	*1-2*
Higher private consumption	0.0	0.0	0.0	0.0	

Percentage of farmers ranking the goal as one of the five most important goals. Ranked in order of declining importance for the group all farmers.

1) Significant differences are in italics ($P<0.10$), normal ($P<0.05$) or bold ($P<0.01$), based on the chi-square tests.

Most farmers reported multiple goals. The highest ranked goal in general was "sustainable and environment-friendly farming", rated as important by more than 80% of the respondents. The goal "producing high quality food" followed close behind. The least important goals were "higher private consumption" and "increase equity".

The goals of converters to organic farming have changed over time. Nearly 70% of the late entrants had "sustainable and environment-friendly farming" as an important goal, while the rate was close to 90% in the old guard. A higher frequency of the late entrants found "have sufficient leisure time" important. Profit maximization ranked very low in the early and mid group, while it was mentioned more frequently among the late entrants. Relatively low ranking of profit maximization has also been found in previous studies of conventional farmers' goals[24,25]. Even though goals of profit and leisure time had become more important, environmental and food quality goals were the most frequently stated goals among the new organic producers, as well.

Motives for conversion

Table 4 shows the percentage of farmers in the groups rating various motives for conversion to organic farming as important, and whether the ratings by the groups differed significantly.

Table 4 Farmers' motives for conversion grouped by year of conversion

Motive	Early conv. (1)	Mid conv. (2)	Late conv. (3)	All	Significant difference[1]
Food quality	62.2	45.6	41.7	49.1	*1-2*, 1-3
Professional challenges	33.3	47.1	45.8	42.9	
Soil fertility, pollution problems	51.1	35.3	27.1	37.3	*1-2*, 1-3
Ideology, philosophy	40.0	35.3	25.0	33.5	
Health risks (pesticides etc.)	24.4	36.8	33.3	32.3	
Animal welfare	22.2	32.4	33.3	29.8	
Profitability	11.1	22.1	37.5	23.6	**1-3**, *2-3*
Organic farming payments	6.7	10.3	35.4	16.8	**1-3**, **2-3**
Natural conditions (soil, climate, etc.)	8.9	7.4	10.4	8.7	
Income stability	2.2	4.4	2.1	3.1	

Percentage of farmers ranking the motive as one of the three most important motives. Ranked in order of declining importance for the group all farmers.

1) Significant differences are in italics ($P<0.10$), normal ($P<0.05$) or bold ($P<0.01$), based on the chi-square tests.

On average, the most important motives for conversion were ”food quality” and ”professional challenges”. The least important motives were ”income stability” and ”natural conditions”. Among the old guard, ”food quality”, ”soil fertility, pollution problems” and ”ideology, philosophy” appeared most frequently, whereas ”professional challenges” and ”food quality” were ranked highest in the later groups.

A significantly higher frequency of the late entrants than respondents in the earlier groups mentioned ”profitability” and the ”organic farming payments” as important motives. However, the traditional environmental, food quality and philosophical concerns were more widely present as motives for conversion. ”Food quality” and ”soil fertility, pollution problems” motives appeared more frequently among the old guard. Our findings are quite similar to previous studies reviewed in Padel[12], and a recent study of Swedish livestock farmers[26].

Norwegian organic farmers have been viewed as consistently idealistic[27]. The understanding of organic farming has partly been different from, for example, Sweden, where tougher economic conditions have forced farmers to become more pragmatic in order to survive. This study indicates that the number of profit-oriented pragmatists is also on the rise in Norway.

Farmers' attitudes

Farmers' perceptions of the attitudinal questions are reported in Table 5.

In general, all groups of organic farmers held very favorable views about the qualities of organic farming methods. For most statements, and five of them significantly, the early converters expressed stronger beliefs in the organic farming methods than later converters. The largest divergence in attitudes between the early and mid group was: "conventional livestock farming improves animal health", and between the early and late group: "use of pesticides decreases food quality".

Table 5 Farmers' attitudes grouped by year of conversion

Statement	Early conv. (1)	Mid conv. (2)	Late conv. (3)	All	Significant difference[1]
"More biodiversity in organic farming"	6.73	6.41	6.38	6.49	*1-3*
"Fertilizer use is necessary to avoid soil exhaustion"	1.41	1.63	1.57	1.55	
"Fertilizers have to be applied to supply nutrients just in time"	1.51	1.62	1.81	1.64	
"Conventional livestock farming improves animal health"	1.38	1.97	2.07	1.83	**1-2**, 1-3
"Conventional farming is more sustainable than organic"	1.82	2.00	1.79	1.89	
"Use of pesticides decreases food quality"	6.44	6.26	5.38	6.06	**1-3**, 2-3
"Less risk of pollution in organic farming"	6.36	5.88	5.89	6.02	*1-2*, *1-3*
"Organic livestock farming better maintains animals' natural requirements"	5.93	5.84	5.77	5.84	
"Organic livestock farming increases the risk of underfeeding and malnutrition"	2.27	2.79	2.26	2.49	*1-2*
"Without herbicides weed problems increase"	2.62	3.24	2.89	2.96	

Mean scores on the statements (Likert-type scale from 1 = totally disagree to 7 = totally agree). Ranked in order of declining pro-organic overall mean score.

1) Significant differences are in italics (P<0.10), normal (P<0.05) or bold (P<0.01), based on t-tests.

The most favorable statements (highest pro-organic overall mean score) were: "larger biodiversity in organic farming" and "fertilizer use is necessary to avoid soil exhaustion".

The statements being least supportive of organic farming were: "without herbicides weed problems increase" and "organic livestock farming increases the risk of underfeeding and malnutrition". About 26% of the farmers agreed (i.e., scored five, six or seven on the Likert-type scale) that weed problems increases without herbicides, while 15% agreed with the increased risk of malnutrition in organic farming. The results indicate that strategies for controlling weeds need to be considered thoroughly for farmland under organic management. Also, organic livestock production has occasionally been criticized because animals have been malnourished[27,28].

The attitudinal responses contrast somewhat with earlier results in this study. Earlier variables were quite different among the three groups, particularly between the old guard and the new producers. In this case, the three groups held quite similar views, albeit with different strength of beliefs. The questions were restricted to environmental values. Questions related to holistic aspects of organic farming, also involving social, cultural and human values, may have resulted in larger dissimilarities between the groups.

Implications and Conclusions

The area of land and number of farms under organic management in Norway has increased rapidly, as in many other countries worldwide. Most of the new players contributing to the growth in organic production must necessarily be conventional farmers converting to organics. In situations where organic farming has become more profitable than conventional agriculture, the organic sector will also attract attention from the pragmatic, profit-oriented farmer and the agribusiness. The new producers will inevitably influence the organic sector.

Dilemmas have thus been created for the organic movement. Some researchers have warned that the movement may be in danger of loosing its identity[5,6,7]. Organic production and marketing seem to be practiced in a more pragmatic and industrial fashion, often called ”conventionalization”, weakening some of the distinctiveness of organic vis-à-vis conventional farming. The organic movement is thus gradually being integrated into the established agricultural systems against which it originally rebelled.

Some influential studies exist within a Californian context, with the production of high value, high intensity vegetables, fruits, and nuts, and where capitalist producers are employing wage labor[5,7]. For decades, California has been at the forefront of agro-industrialization and agricultural intensification. In Norway, the policy environment, natural conditions, social values, farming traditions and enterprise mixes are different, cf. the section on organic farming in Norway.

Even though the agro-industrialization forces are weaker in Norway, some findings in this study identified trends towards more pragmatic forms of organic production and a more business oriented approach among the new dairy producers. The old guard tended to have a more diverse enterprise mix, and various crops, livestock and poultry to make the farm a self-sustained environment. Later converting farmers were more specialized. Late entrants' dairy herds had higher inputs of concentrates, achieved higher milk yields, and had a higher incidence of veterinary treatments. Few of the new producers used alternative medicine. Farming goals of profit and leisure time increased in popularity among the late entrants. Among the late entrants, a considerable share also seemed to convert because of the prospects of more profitable farming and the additional organic farming payments rather than because of an ideological commitment to organic farming.

Others have described organic agriculture as a useful and complex example of the way in which nature features in food production and consumption[8,9]. Recent examples of the organic movement's resistance against genetically engineered food[29], points to a still critical position to the established agribusiness and food supply systems. Our findings suggest a majority of fairly committed organic dairy farmers in Norway. Livestock and disease management practices tended to be more pragmatic (in relation to the ideals of organic farming) among late entrants, but the greater part of the herds had a moderate or even low milk production per cow. The respondents were not a homogenous group with regard to their farming goals and motivations for conversion, not even among those who converted at about the same time. Although financial considerations have become quite important for a considerable number of the late entrants' decision to go organic, environmental, food quality, and philosophical concerns were still more widely present as goals and motives. Finally, all groups of farmers held favorable views about the environmental qualities of the organic farming methods, albeit with different strengths of beliefs.

The flexible, pragmatic, environmentally concerned, but not ideologically committed producers seem to share ideas with principles of integrated farming systems. These principles can be conceptualized as a "third way " or middle course for agriculture between conventional and organic farming[30]. The pragmatists are quite likely to have other values and priorities than the committed farmers in the old guard. Commercially minded farmers, at least in Sweden, are more critical of the constraints of organic farming standards[26]. They may prefer to lobby for more pragmatic standards of organic production. The evolution of organic standards can have wide-reaching impacts on the organic sector, making a significant difference in who can participate in organic production and of what methods of production will be used[7].

One limitation of our study is that accounting for differences in a two-by-two fashion using bivariate analyses cannot capture complex patterns of relationships among multiple variables[31]. Application of multivariate techniques would reduce this limitation. For example, characteristics of business-oriented farmers, independent of conversion time, compared to the more idealistic organic farmers could be further examined. Farm management styles can be identified by use of cluster analysis or the Q methodology[24,32]. The latter approach encompasses a particular method of data collection, not used in our survey design. Because we used a one-off survey, the study does not indicate what changes may be occurring among farmers over time. Converting farmers' management practices, goals and attitudes may be more influenced by organic values as they become more experienced with organic farming. On the other hand, the committed, life-style oriented farmers may also turn into business-oriented players themselves. Longitudinal studies with repeated observations over time on respondents would provide answers to such questions. However, even within these limitations, we provide valuable information about shifts in motives, farm and social characteristics, etc. among those converting to organic farming. And in any case, one needs to recognize that such shifts are a typical feature of any diffusion process, and not an inherent shortcoming of those currently converting[12].

The policy and regulatory environment influences development paths in organic farming in a complex, interactive manner together with a range of other social, economic, and natural factors. According to Guthman[7], a regulatory structure that only attempts to support a price premium contributes to the erosion of organic practices. In Norway, support programs have so far succeeded in encouraging organic production and simultaneously keeping the small-scale agrarian structure alive. Although the new producers in Norway practice organic farming in a more pragmatic way than the old guard, the intensity in milk production is still rather low. Tensions among organic farmers in views on sound ways of practice farming and marketing must however be expected. Producers going far beyond the organic minimum standards may prefer separate, stricter regulation schemes, to signal a more idealistic farming system. Pragmatic and committed organic producers may react differently to changes in prices, farm policies and organic regulations[33]. In particular, if economic terms become harder, farmers who go organic just for the money may be more likely to return to conventional farming than those committed to broader organic principles.

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Vedlegg 6

Motives and potential for conversion to organic farming in Norway

Matthias Koesling[1], Martha Ebbesvik[1], Gudbrand Lien[2],
Ola Flaten[2], and Paul Steinar Valle[3]
[1]Norwegian Centre for Ecological Agriculture
[2]Norwegian Agricultural Economics Research Institute
[3]The Norwegian School of Veterinary Science
Corresponding author: Matthias.koesling@norsok.no

Abstract

In the literature there is lack of information regarding the proportion of conventional farmers who consider converting to organic or at least are not excluding to do so. What differences in motives and perceptions exist between organic farmers, newcomers, potential converters, and the farmers who reject the organic farming philosophy? This exploratory study, based on a postal survey undertaken among Norwegian crop and dairy farmers (n=1018), aims to fill parts of these gaps. The results of the study show that 74% of the conventional farmers refuse, 4% plan to convert, while 18% of the conventional farmers are uncertain about what kind of production system they will have in 2009. If 4% of the today's conventional farmers convert within 2009, the prevailing aim of 10% organically managed area will not be reached. Different factors are pointed out to contribute to stimulate more farmers to start a conversion.

Keywords: Organic farming, motivation, conversion, survey, Norway

Introduction

Organic farming methods is said to contribute to greater product variety, provision of public goods linked to rural development (Commission of the European Communities, 2002), reduced energy use (Stolze and Dabbert, 2000), soil protection, and biodiversity (Mäder et al., 2002). The ban of synthetic fertilisers and limits on livestock stocking rates restricts the potential for nutrient pollution. The European Union actively seeks to increase the number of organic farms by including organic means and measures (Commission of the European Communities, 2004). In Norway initiatives in the 1990's have encouraged many farmers to convert to organic production. A scheme to apply for gratis organic milk quota was launched and area payments for producing organic grain increased. Organic premiums on several products, milk and beef included, were introduced in 1996. The number of organic farms has increased from 423 in 1991 to 2484 in 2004 (Debio, 2005). In the same period, the area of organically certified farmland and land in conversion increased from 2443 ha to 41,036 ha. In 2004, the organic area amounted to 3.3% of the total farmland.

One of the Ministry of Agriculture's (Landbruksdepartementet, 1999) prevailing aims is to achieve ten per cent organically managed area by the end of 2009. The goal is however to coincide with adequate development of the organic markets. The share of organically products reaching consumers as organic products in Norway is low (Jervell, Borgen and Flaten, 2004).

To reach the goal of 10% organic farmland the number of organic farmers has to be tripled; in the next four years about 1250 farmers has to convert to organic farming each year, i.e. well 2% of the conventional farmers. If many farmers defect from certified organic farming the need for converters will be higher.

Various studies, most of them based on qualitative analysis (e.g., Duram, 2000; Fairweather, 1999; Lockeretz, 1997; Lund, Hemlin and Lockeretz, 2002), but also quantitative analysis of surveys (e.g., Kirner, 2001; Schneeberger, Darnhofer and Eder, 2002; Darnhofer, Schneeberger and Freyer, 2005) have examined organic farmers characteristics, motives, attitudes and barriers related to organic farming and the conversion process. In these studies mainly organic farmers were asked.

There are few studies examining the proportion of conventional farmers who consider to convert to organic or at least are not excluding to do so (Midmore et al., 2001; Kirner and Schneeberger, 1999; Schneeberger, Darnhofer and Eder, 2002; Schneeberger and Kirner, 2001), and what differences in motives and perceptions exist between organic farmers, newcomers, potential converters, and farmers who are "committed conventional" and completely reject to farm organic. What are the motives and what are the barriers (Schneeberger, Darnhofer and Eder, 2002; Schneeberger and Kirner, 2001) for these different groups of farmers? More research-based information about these issues would be useful for future targeted policy making (so the government can reach their 10% organic area goal). This kind of study should also give farm advisers and researchers more practical insights in order to communicate better and give better advice.

This exploratory study aims to fill parts of these gaps in the literature by providing empirical information about Norwegian farmers' personal and farm characteristics, farming goals, motives for conversion or not conversion and attitudes to organic and conventional farming, grouped by planned farming system for the future. Further, the potential for achieving the policy goal of 10% is discussed.

Materials and methods

The data reported here were collected as a part of a larger questionnaire of risk and risk management in farming. The Norwegian Agricultural Authority (SLF) has a register of farmers who receive support payments (i.e., all farmers). Based on the 2001 applications, there were more than 17 800 dairy farmers (including 325 organic) and more than 15 600 crop farmers (202 organic). From this SLF register 850 crop and 862 dairy farmers were sampled. Conventional farmers were selected using simple random sampling, while all organic dairy and crop farmers received the questionnaire. We were informed that 34 of these farmers had quit farming. Hence the number of possible respondents was reduced to 1678. After two reminders 1033 farmers had returned the questionnaire. The effective response rate was 62%. Some 15 responses were discarded because of incomplete returns, and 1018 farmers were then used by statistical analysis.

Because of small herd sizes in Norway, dairy farms were defined as farms having more than five dairy cows. Crop farms were defined as farms having more than 1 ha grain, or more than 0.5 ha of potatoes, or more than 0.2 ha of intensive crops (vegetables, fruit, or berries). Dairy farms, which also met the cropping criteria, were specifically excluded from the crop group. Dairy and crop farmers account for about 60% of all Norwegian farmers. Other important farm enterprises in Norway are sheep, swine and specialised beef production.

The questionnaire, first sent out in January 2003, consisted of questions related to: (1) farm and farmer characteristics; (2) farmers' goals, future plans and motivations for their farming system; (3) a series of statements designed to test their attitudes with regard to characteristics of organic farming compared to conventional farming; (4) animal disease management strategies; and (5) farmers' risk perceptions and management responses. The risk questions have been thoroughly examined in other studies (e.g., Koesling et al., 2004; Flaten et al., 2005), and will not be handled in this research.

From a list of 14 farming goals, the respondents were asked to select up to five goals as most important for them. In the same way, from a list of 10 motives for organic and conventional farming, the respondents were asked to select up to three motives for their farming system as most important for them.

Respondents' attitudes were examined by means of a series of statements. Farmers were asked to score each attitudinal question on a Likert-type scale from 1 (totally disagree) to 7 (totally agree).

The farmers' characteristics, goals, motives and attitudes were summarized with mean values. Mean values obtained for the different groups were compared by one-way ANOVA and standard *t*-tests for metric variables (including Likert-type scale variables) (variables for farm and farmer characteristics) and chi-square tests for nonmetric variables (variables for goals, motives and attitudes).

Data (2002) from the Norwegian Agricultural Authority (SLF) and the Norwegian Dairy Herd Recording System were merged with the questionnaire data.

Results and discussion

Future plans

The farmers were asked what kind of production system they planned to practice by the end of the year 2009. Nearly three fourth of the conventional farmers (C) stated that they did not plan to convert to organic agriculture (Table 1). Four per cent had plans to convert the whole farm or parts of the farm to organic farming practices (N, newcomers) and eighteen per cent of the conventional farmers were uncertain whether they would convert or not (P, potential converters). Among the group of organic farmers and farms in conversion, two per cent of the farmers planned to revert to conventional farming. Some 93 per cent of the organic farmers (O) plan to still farm organic in 2009. Those which did not answer the above question and the organic farmers which planned to defect from certified organic farming were not taken into account in subsequent analyses.

Table 1 Planned farming system in 2009

	Farming system 2003			
	Conventional		Organic or in conversion	
Farming system 2009	Number of farms	%	Number of farms	%
a) No plans to convert to organic agriculture	537	74	-	-
b) Continue with organic farming	-	-	227	76
c) The whole farm will be converted*	8	1	38	13
d) Parts of the farm will be converted*	22	3	13	4
e) Reversion	-	-	5	2
f) Do not know	129	18	6	2
g) No answer	25	4	8	3
Sum (a to g)	721	100	297	100
Conventional farmers with no plans to convert, C (a)	537	74	-	-
Organic newcomers, N (c+d)	30	4		
Potential converters, P (f)	129	18	-	-
Organic farmers, O (b+c+d+f)	-	-	284	95

*: In Norway parallel production of organic and conventional farming is allowed if there is a clear partition between both production systems.

If just 4% of the today's conventional farmers convert the whole farm or parts of the farm to organic farming practices within the end of 2009, the certified organic area will rise from 3.3% to about 5 to 6%. Thus different means have to be used to stimulate more farmers to start a conversion if the aim of 10% organically managed area (Landbruksdepartementet, 1999) shall be reached.

There are indications of that a huge growth of new organic farmers will lead to a shift in ideals and values within the organic farming movement compared to the early organic community (e.g., Flaten et al., 20056; Rigby, Young and Burton, 2001). This may, in the next step, influence the future development of the organic movement (e.g., Frischknecht, 2000; Woodward, Fleming and Vogtman, 1996). Until the 1980's it has manly been the farmers who have driven the development of organic farming, in more recent years the governments and society has become involved.

Key respondent and farm characteristics

The key characteristics of the four groups are shown in Table 2. Both the mean scores in the groups and the statistical significance between the groups are reported.

Table 2 Key characteristics of farmers and farms grouped by farming plans 2009

	O[1)]	Std. error	N[1)]	Std. error	P[1)]	Std. error	C[1)]	Std. error	Significance[4)]
Number of farms	284		30		129		537		
All farms									
Farmland, ha[2)]	27.6	1.2	27.1	3.0	21.1	1.4	24.8	0.7	0.007
Grain and oil seeds, ha[2)]	8.3	0.8	15.2	2.7	9.3	1.2	11.8	0.7	0.005
Meadow, ha[2)]	17.8	0.8	10.6	2.5	11.3	1.1	12.2	0.6	0.000
Farming experience, years	21.8	0.6	24.4	2.0	23.3	1.0	24.8	0.5	0.003
Age of farmer	48.1	0.6	49.3	1.7	49.0	0.8	48.5	0.4	0.811
Gender, % female owners	11.4		8.3		9.8		5.6		
University or college education, % of farmers	44.0		23.3		20.9		23.6		
Farmers with agricultural education, % of farmers	73.2		56.7		51.6		56.2		
Percentage of farms located close to urban areas	39.3		24.1		46.4		43.7		
Percentage of farms with dairy production (chi^2-test)	53.2		33.3		49.6		51.2		0.222
Only farms with dairy production									
Number of dairy cows[2)]	17.1	0.6	13.5	1.1	16.7	1.2	17.1	0.5	0.539
Milk yield per cow years, kg[3)]	5144	89.5	5757	237.2	5955	124.8	6246	58.8	0.000
Percentage concentrates, %[3)]	27.3	1.9	49.8	9.6	42.4	3.0	39.1	1.0	0.000

1) O: organic farms, N: newcomers, P: potential converters, and C: conventional farms with no plans to convert. SeTable 1.
2) Data (2002) from the Norwegian Agricultural Authority.
3) Data (2002) from the Norwegian Herd Recording System.
4) Significance that the four groups differed for metric variables are based on one-way ANOVA.

Organic farmers and newcomers had most farmland, about 28 ha. Both newcomers and conventional farmers used more farmland to grow grain and oil seeds than organic farmers. Organic farmers used nearly two third of the farmland to produce forage.

The average organic farmer had nearly 22 years of farming experience, about three years less than the average conventional farmers had. Nearly three fourth of the organic farmers had agricultural education, more than the other three groups had. Among organic farmers were 44%, while less than 24% of newcomers, conventional farmers, and potential converters were with university or college education. Among organic farmers there were more female owners (11.4%) than among conventional farmers (5.6%). The number of female owners is lower, but the tendency is in line with Storstad and Bjørkhaug (2003), who sampled from all organic farmers in Norway.

On dairy farms the number of cows was not really different, but the milk yield per cow years was lowest on organic farms, 5144 kg. Having lot of meadow and a low milk yield per cow permits organic farmers to use just 27.3% concentrates; this is less than all other farmers used. Surprisingly in relation to the findings from Duram (1999) newcomers were using 50% concentrates, some of them will get a challenge to reduce to less than 40% concentrates when converting to organic agriculture.

To compare the level of support payments in Norway (SLF, 2005) we estimated the yearly payments for the group of organic and conventional farmers on basis of agricultural area and dairy production. Other animals than dairy cows on the farm were not taken into account. For the average conventional farm with about 12 ha meadow, 12 ha grain, and 17 dairy cows the support payments would be roughly about NOK (Norwegain kroner, NOK 8.00 ≈ € 1) 181 000. The support payments are lower in urban areas and higher in mountain and northern areas. For the average organic farm the general support payments would be about NOK 184 000 and the additional organic subsidies[1] would contribute to be NOK 41 000.

Farmer's goals

Table 3 shows the farmers percentage rating of goals along with the results of the significance tests.

Most farmers reported multiple goals, not only one. Between organic and conventional farmers there are many significant differences, followed by number of differences between organic farmers and potential converters. There where just few differences in ranking goals between potential converters and conventional farmers. The fact that there were just 30 newcomers may be one reason for the few significant differences between newcomers and the other groups. Organic farmers differed in relation to the other groups by ranking the goal 'sustainable and environmental friendly farming' highest, rated as important by nearly eighty per cent. On second place, followed close behind, and third they ranked to 'produce food of good quality' and to have 'reliable and stable income'. The other three groups ranked these two goals on place one and two.

Conventional farmers and potential converters ranked to 'improve the farm for the next generation', to 'reduce debt, become free from debt', and to 'maximise profit' higher than organic farmers did. Profit maximization was given a rather low score, as also found in many other studies (e.g., Bergevoet et al., 2004; Gasson et al., 1988; Willock et al., 1999). Conventional farmers ranked to 'work with animals

[1] Additional organic farming payments are paid to certified organic area after a two year conversion period. For the conversion period the farmer gets a one-time payment of 7500 NOK/ha (permanent pasture not included). The additional organic area subsidy is 2500 NOK/ha for grain, potatoes, vegetables, fruits, and berries and 550 NOK/ha for other organic area for certified organic production in 2005. Per milking cow the additional organic subsidy is NOK 630 (NOK 880 in mountain areas and the western and northern counties of Norway).

or crops' much lower than organic farmers did. The least important goals for all farmers were 'higher private consumption' (no important ranking at all), 'increase equity', and 'social contacts'.

Table 3 Farmers' goals for farming

Farming goal	Organic farmers %	New-comers %	Potential converters %	Con-ventional farmers %	Significant differences[1]
Sustainable and environment-friendly farming	79.6	53.3	44.2	40.8	**O-N** **O-P** **O-C**
Producing high quality food	76.8	76.7	62.8	71.9	**O-P** P-C
Reliable and stable income	52.8	70.0	62.8	70.6	*O-N* *O-P* **O-C** *P-C*
Time for family, living quality for children	48.6	46.7	51.9	51.2	
Independency, self employment	45.4	43.3	38.0	47.9	P-C
Improve the farm for next generation	37.3	56.7	48.8	52.0	O-N O-P **O-C**
Work with animals/crops	37.3	23.3	19.4	21.8	**O-P** **O-C**
Have sufficient leisure time	24.3	20.0	24.0	26.1	
Reduce debt, become free of debt	20.1	16.7	31.0	29.6	O-P **O-C**
Continue to be a farmer	20.1	20.0	26.4	28.1	O-C
Maximise profit	15.8	6.7	23.3	27.9	*O-P* **O-C** N-P N-C
Social contacts	6.0	6.7	6.2	6.0	
Increase equity	2.1	0.0	3.9	5.8	O-C
Higher private consumption	0.7	3.3	1.6	2.6	*O-C*

Percentage of farmers ranking the goal in top five. Ranked in order of declining importance for organic farmers.
1) Significant differences between groups are in italics ($P<0.10$), normal ($P<0.05$), or bold ($P<0.01$), based on a chi-square test.

Motives for organic farming

Figure 1 shows the percentage of farmers in the groups potential converters (P) and organic farmers' (O) rating various motives for conversion to organic farming as important, and whether the ratings by the groups differed significantly.

For 'profitability', 'organic farming payments', and 'food quality' the two groups ranked the motives different at $p<0.05$ and 'ideology, philosophy' at $p<0.10$.

For organic farmers the most important motive for organic farming was 'food quality. 'Higher soil fertility, less pollution problems' and 'professional challenges' was ranked on place two and three. Other important motives were 'less health risk' and 'ideological and philosophic reasons'. Of less importance were 'animal welfare', 'higher profitability', and 'organic farming payments'. The least important motives were 'natural conditions' and 'more stable income'.

The findings show that the traditional environmental, food quality and philosophical concerns are still widely present as goals and motivations for organic farmers. So our findings are quite similar to earlier studies reviewed in Padel (2001) and Storstad and Bjørkhaug (2003). However, for farmers planning to convert the next years 'production of high quality food' ($p=0.016$) and 'ideological and philosophic reasons' ($p=0.051$) are of less importance than for the current organic farmers. Whereas economic motives as 'profitability' ($p=0.047$), 'organic farming payments' (p=0.049) are getting more important for the recent converters, as reported in Rigby et al. (2001), Duram (1999), and Flaten et al. (2006). This may reflect the way public authorities try to influence the development organic agriculture by using economic incentives to motivate farmers so that the area target can be met. It should be noted that Norwegian organic farmers have been viewed as more consistently idealistic, and in part have had a different understanding of organic farming than in, for example, Sweden, where tougher economic conditions have forced farmers to become more pragmatic in order to survive (Lund and Algers, 2003). But the study of Flaten et al. (2006) indicates, as our study, that the number of 'profit oriented pragmatists' also is upward in Norway.

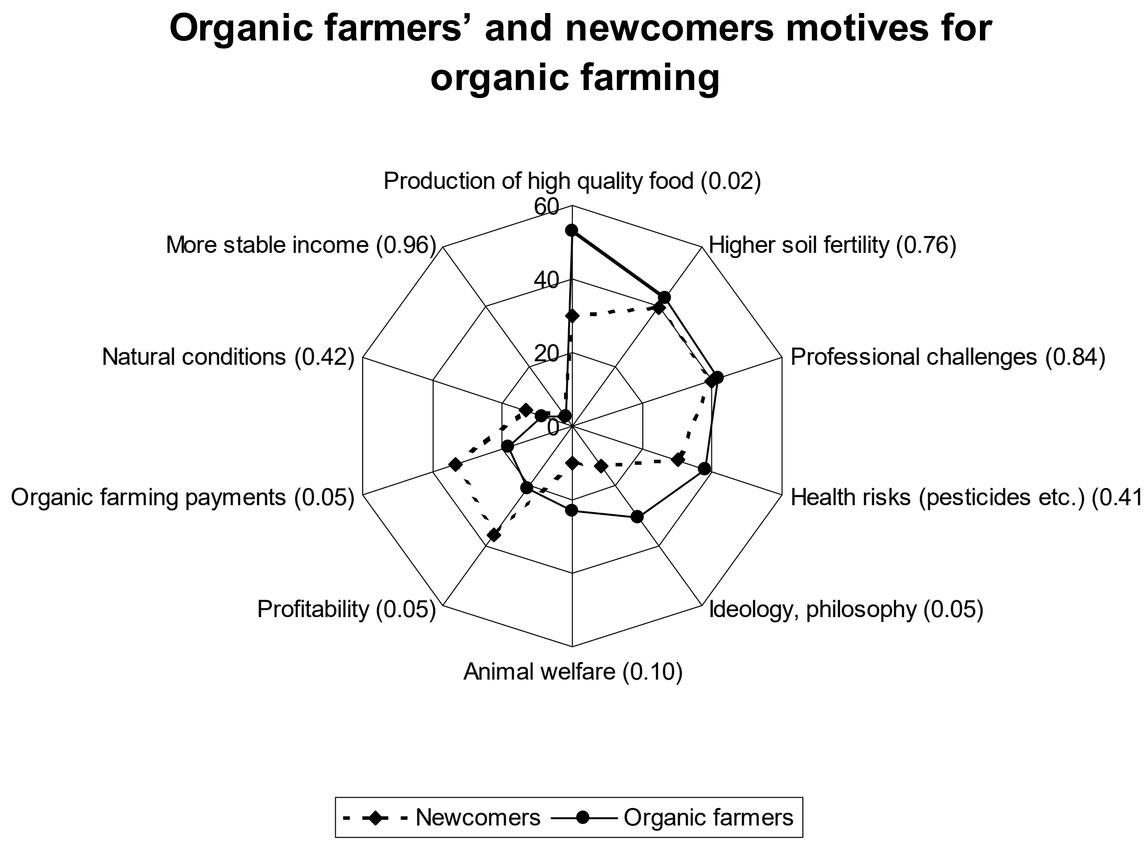

Figure 1 *Organic farmers' and newcomers' motives for organic farming. Percentage of farmers ranking the motive in top three. Significance between the two groups based on a chi-square test in parenthesis.*

Motives for conventional farming

Figure 2 shows the percentage of conventional farmers' and newcomers' rating motives for conventional farming as important, some of them are in relation to organic farming.

There were no significant differences in rating between the mentioned motives unless that a higher frequency of the conventional farmers than the newcomers rated 'higher profitability' as an important motive for conventional farming (p=0.081). This may indicate both that the farmers planning to convert expect to gain future benefits for organic farming (Sullivan et al., 1996) and that economic conditions are influencing the decision to convert or not (Rigby, Young and Burton, 2001; Pietola and Oude Lansink, 2001).

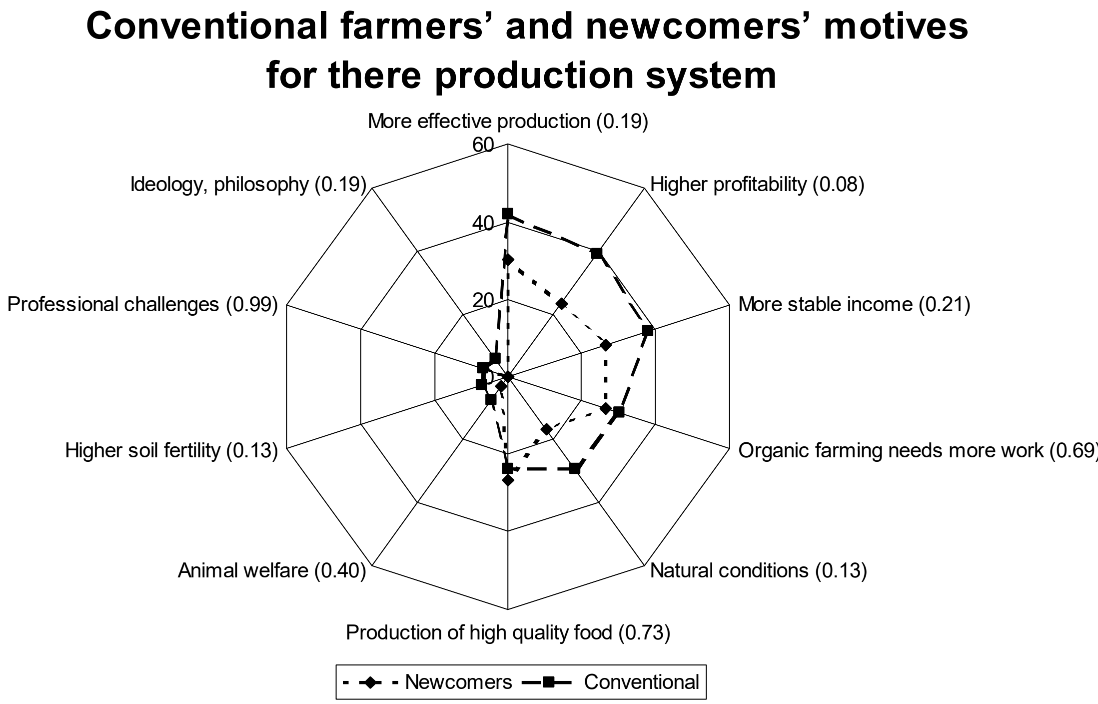

Figure 2 Conventional farmers' and newcomers' motives for their production system. Percentage of farmers ranking the motive in top three. Significance between the two groups based on a chi-square test in parenthesis.

The most important motive for both groups was 'more effective production'. Other highly rated motives were 'higher profitability', 'more stable income', 'organic farming needs more work', 'natural conditions', and 'production of high quality food'. These findings show that financial considerations are important for both groups for choosing their production system and Lien et al. (2006) have reported returns in organic cropping systems to be more variable than the conventional ones.

Of less importance for both groups were 'animal welfare', 'higher soil fertility, less pollution problems', 'professional challenges', and 'ideological and philosophic reasons'.

Farmers' attitudes

Figure 3 shows how the four farmer groups rated different statements on farming.

The four groups differed significantly for most of the statements designed to reflect farmers' attitudes about characteristics of organic and conventional farming. All groups perceived, with various degrees of beliefs, that organic farming allows larger biodiversity and has less risk of pollution. Earlier studies also support that organic farming practises are beneficial to the diversity of flora and fauna through increases in abundance and species richness (e.g., Hole et al., 2005).

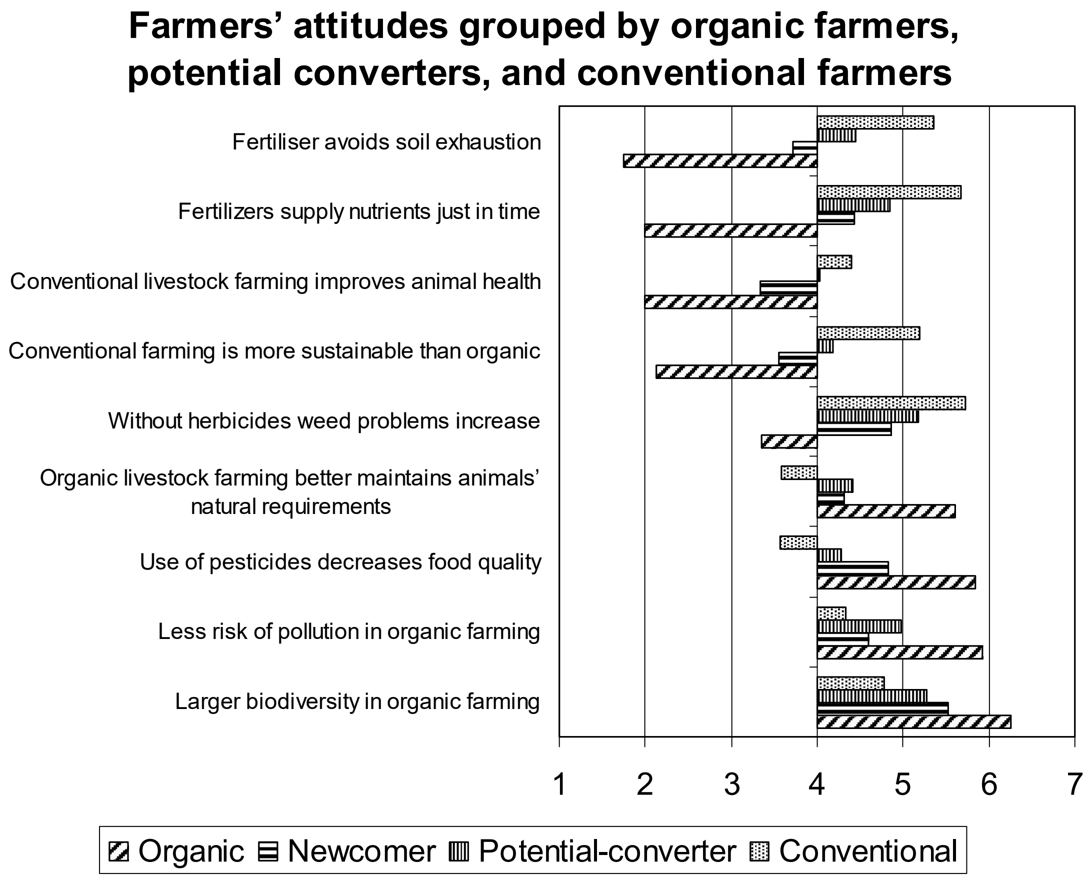

Figure 3 *Farmers' attitudes grouped by organic farmers, potential converters, and conventional farmers. Mean score (1=totally disagree, 7=totally agree) for conventional and organic farmers. The significance levels are not reported in the figure, but are available from the authors upon request.*

The difference for rating the statements were always significant between organic and conventional farmers (p<0.01 for all statements), and the absolute difference on the scale was always highest between these two of the four investigated groups. Mostly both organic and conventional farmers held more favourable views about the qualities of their farming methods in relation to the others. The answers for newcomers were always between those from organic and conventional farmers.

The largest difference between organic farmers and potential converters in rating the statements was, in declining order: 'fertilisers has to be applied to supply nutrients just in time', 'fertilisers are necessary to avoid soil exhaustion', and 'conventional farming is more sustainable than organic'. Newcomers differed significant (p<0.10) in relation to potential converters by ranking all these statements more like the conventional farmers did, unless the first one. The newcomers ranked more like the organic farmers did, but still the difference to organic farmers was significant (p<0.01).

Both organic farmers, newcomers, and potential converters rated that 'use of pesticides decreases food quality' and 'organic livestock farming better maintains animals' natural requirements' significantly different than conventional farmers. Earlier research have concluded that animal welfare in organic herds are the same as or better than in conventional herds (eg., Hovi et al., 2003).

The statements 'conventional farming is more sustainable than organic' and 'conventional livestock farming improves animal health' were judged about neutral by the potential converters. The questions about fertilisers were answered by the potential converters more similar to conventional than to organic farmers. Hence, potential converters were of the opinion that fertilisers are necessary to avoid soil exhaustion and to supply nutrients just in time. Farming without herbicides would be a challenge since both newcomers, potential converters, and conventional farmers expected that weed problems will increase without herbicides. The rating of this statement showed that organic farmers too feel that weed management still is a challenge. The results indicate that strategies for controlling weeds need to be considered thoroughly for farmland under organic management (Fairweather, 1999).

Conclusions

The aim of the study was to give detailed information about farmers in relation to organic agriculture; How many of the conventional farmers have plans to convert, are considering or at least not excluding a conversion, and how many are excluding to convert. What are the goals for farming, motives for conversion or not and what are the attitudes to the different production systems.

The results from the questionnaire show that 74% of the conventional farmers were not interested to change their production system to organic farming. Some 4%, named the newcomers, had plans to convert the whole or part of the farm to organic farming, 18%, the potential converters, were not sure what kind of production system they would have by the end of 2009. The study did not include those new farmers who will farm organically right from the start, rather than having converted. These may add to the potential converters among current conventional farmers identified in this study.

If the aim is to achieve 10% organically managed area it will be favourable to focus on the 'newcomers' and 'potential converters' among the conventional farmers. If all newcomers and every fourth of the potential converters convert to organic farming, the goal would be reached. To stimulate farmers of these two groups to start a conversion, various efforts are required. Farmers need information on how to solve practical challenges in line with the organic regulations, associated to organic farming. How to handle weed problems, how to supply nutrients to the plants (both quantity and timing), how to reduce the need for work, and how to get a fair income? Where these information's are not accessible, more research is needed. In addition there should be offered information about the influence of organic farming practice on food quality, soil fertility, and the environment.

Since the process of converting a farm with both farmland and animals takes time, it is important for farmers that the political conditions and regulations for organic farming are somehow stable and predictable. In a situation where organic farmers perceive organic farming payments among the most important risk sources (Koesling et al., 2004; Flaten et al., 2005), to start a conversion must feel risky. All three groups of conventional farmers mentioned a reliable and stable income as one of the most important farming goals, so uncertainty about additional organic farming payments will discourage them to plan a conversion. Especially because economic incentives play an important role in farmer's decision to convert or not (Pietola and Oude Lansink, 2001). Therefore, to get a clearer, more stable and predictable agricultural policy, policy makers should be cautious about changing policy capriciously and they should consider the scope for strategic policy initiatives that give farmers some greater confidence about the longer term.

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Vedlegg 7

Hvem blir de nye økobøndene?*

Matthias Koesling
Norsk senter for økologisk landbruk

Hvis 15 prosent av matproduksjonen og matforbruket i 2015 skal være økologisk, så må omleggingsfarten øke. En spørreundersøkelse viser at det er 4 prosent som vil legge om, mens 18 prosent er potensielle nykommere.

I 2003 gjennomførte Norges veterinærhøgskole, NILF og NORSØK en spørreundersøkelse, hvor 1 018 planteprodusenter og melkebønder svarte. Disse drev enten konvensjonelt eller økologisk.

18 % potensielle omleggere

Undersøkelsen viser at for 74 % av de konvensjonelle bøndene er det utelukket å legge om til økologisk drift innen 2009, 18 % var usikre (potensielle omleggere) og 4 % var fast bestemt på å legge om (nykommere). 93 % av økobøndene var sikre på at de ville fortsette med økologisk drift.

Mest forareal pa økogarder

Gruppene økobønder og nykommere hadde i gjennomsnitt mest jordbruksareal med vel 270 dekar. Økobøndene brukte nesten to tredjedeler av arealet til å dyrke fôr, mye mer enn de andre gjør. Både konvensjonelle bønder og nykommere brukte mer areal til dyrking av korn og oljevekster.

Nykommere 50 % kraftfor

Med ca 5 100 kg melk per årsku i snitt har økologiske garder melkebruk lavest avdrått. De gir også minst kraftfôr, nemlig 27 % per år.

Nykommere har færrest dyr med vel 13 årskyr og bruker mest kraftfôr i fôrrasjonen, nesten 50 %. For noen av disse gårdene vil det være en utfordring å tilfredsstille kravet om å ikke bruke mer enn 40 % kraftfôr i fôrrasjonen ved økologisk drift.

Bærekraftig drift viktigst

I forhold til de andre gruppene skilte økobønder seg ut ved at nesten 80 % av dem rangerte «å drive miljøvennlig og bærekraftig» som viktigste mål for gardsdrifta, tett fulgt av «å produsere mat av god kvalitet». På plass tre kom «sikker og stabil inntekt».

* Artikkelen er trykt i fagtidsskriftet *Økologisk landbruk* nr. 4/05, s. 34-35.

De tre andre gruppene rangerte målene om matkvalitet og inntekt på plass en og to. Både konvensjonelle bønder og potensielle omleggere rangerte målene «å forbedre gården til neste generasjon», «å ha mindre gjeld, bli gjeldfri» og «å få størst mulig inntekt» høyere enn økobønder.

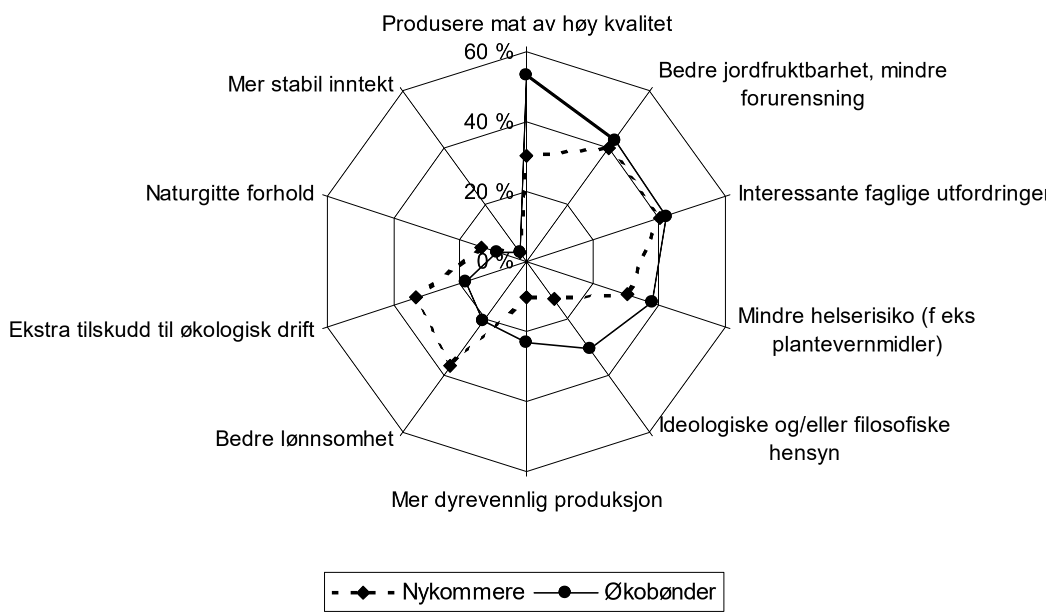
For ingen av gruppene var «å få størst mulig inntekt» særlig viktig. En av de som svarte skrev at han aldri hadde blitt bonde hvis dette målet hadde vært viktig.

Konvensjonelle bønder la mindre vekt på å arbeide med dyr og planter enn det økobønder gjorde. For ingen av gruppene hadde det å øke privatforbruket, øke formuen og dekke sosiale behov nevneverdig betydning.

Produsere mat av høy kvalitet

For økobønder var det «å produsere mat av høy kvalitet» det viktigste motivet for å drive økologisk, se figur 1. «Bedre jordfruktbarhet, mindre forurensning» og «faglige utfordringer» fulgte på plass to og tre. Andre viktige motiver var «mindre helserisiko» og «ideologiske og filosofiske grunner». Mindre viktig var «dyrevelferd», «bedre lønnsomhet» og «ekstra tilskudd til økologisk drift». Ubetydelig var «naturgitte forhold» og «mer stabil inntekt».

Dette viser at de tradisjonelle motivene miljø, matvarekvalitet og ideologiske, filosofiske grunner fortsatt er viktige.



Figur 1 Prosent bønder som oppga motivet som ett av de tre viktigste.

Økonomiske motiver

For bønder som har planlagt å legge om i løpet av de neste årene er derimot produksjon av «mat med høy kvalitet» og «ideologiske, filosofiske grunner» langt mindre viktig. Samtidig er økonomiske motiver som «bedre lønnsomhet» og «ekstra tilskudd ved økologisk drift» viktigere for nykommere enn for økobønder.

Denne utviklingen kan være et resultat av landbrukspolitikken, der det hovedsakelig har vært brukt økonomiske virkemidler for å motivere bønder til å legge om.

Mer effektiv drift

Mer effektiv drift er et viktig argument for å drive konvensjonelt. Nykommerne nevnte «mulighetene for effektiv drift (bruk av kunstgjødsel, plantevernmidler, innkjøpt fôr m.m.)» som den viktigste grunnen for å drive konvensjonelt.

Andre viktige motiver var «bedre lønnsomhet», «mer stabil inntekt», «mindre arbeidsbehov enn ved økologisk drift», «naturgitte forhold» og «produksjon av matvarer av høy kvalitet». De samme motivene ble også nevnt av gruppen konvensjonelle bønder.

Disse resultatene viser at økonomiske motiver vektlegges av både konvensjonelle bønder og de som vil legge om. De tyder også på at bøndene oppfatter konvensjonell drift som tryggere med hensyn til inntekt.

«Dyrevelferd», «bedre jordfruktbarhet, mindre forurensning», «interessante faglige utfordringer» og «ideologiske, filosofiske hensyn» ble av de to gruppene ikke nevnt i særlig grad som grunn for å drive konvensjonelt.

Ulike meninger

Alle de fire gruppene mente at økologisk landbruk gir «mer rom for større biologisk mangfold» og innebærer «mindre fare for forurensning», dog i forskjellig grad.

Gjennomgående var økologiske og konvensjonelle bønder mest positive til den driftsformen de hadde valgt. Nykommeres vurdering lå alltid mellom økobønder og konvensjonelle bønder. Konvensjonelle bønder var enig i at «kunstgjødsel må til for å gi plantene næring til rett tid», «kunstgjødsel er nødvendig for ikke å pine ut jorda» og «konvensjonelt jordbruk er mer bærekraftig enn økologisk», mens økobønder var ganske uenig i forhold til disse utsagn.

Vanskelig a kutte ut kunstgjødsel og sprøytemidler

Både økobønder, nykommere og potensielle omleggere var enige i at «kjemiske plantevernmidler reduserer matvarekvaliteten» og at «økologisk dyrehold er bedre for husdyras naturlige behov/velferd».

For potensielle omleggere er bruken av «kunstgjødsel viktig for å gi plantene næring til rett tid» og for å unngå utpining av jorda, men mindre viktig enn for konvensjonelle bønder. Både nykommere, potensielle omleggere og konvensjonelle bønder forventer at ugrasmengden øker uten bruk av kjemiske plantevernmidler. Også økobønder antydet at det ikke er lett å handtere ugras.

15 % kommer ikke av seg selv

Når regjeringen har 15 % økologisk produksjon som mål, vil det antakelig være mest hensiktsmessig å rette tiltakene mot nykommere og potensielle omleggere, samt å bidra til at færrest mulig økobønder melder seg ut av kontrollordningen.

For å få nykommere og potensielle omleggere til å starte omleggingen til økologisk drift hjelper det lite med enkelttiltak. Bønder trenger kunnskap om hvordan praktiske utfordringer kan løses i henhold til regelverket: ugrasproblemene, næringsforsyning til plantene, arbeidsbehovet og tilstrekkelig inntekt.

Ut over dette er det viktig å informere om økologisk landbruks positive effekt på matvarekvalitet, jordfruktbarhet og miljøet, å hjelpe til at markedet for økologiske produkt utvikles og at det gis tydelige signaler at det ønskes mer økologisk produksjon.

Politikk den største risikoen

Politikk ble oppfattet som den største risikokilden i forhold til gardsdrifta. Siden omleggingsperioden for både jord og dyr tar tid er det derfor ekstra viktig at lover, regler og tilskuddsordninger er forutsigbare.

Skulle antall økobønder øke til 15 % vil dette selvfølgelig innebære en endring av økomiljøet. Resultatene i spørreundersøkelsen gir ingen informasjon om nykommere og potensielle omleggere på sikt vil bli mer lik dagens økobønder eller ikke.

Vi retter en stor takk til alle bøndene i spørreundersøkelsen for deres velvilje til å svare på alle spørsmålene.

Vedlegg 8

Management and risk characteristics of part-time and full-time farmers in Norway*

Gudbrand Lien[1,2], Ola Flaten[1], Anne Moxnes Jervell[3], Martha Ebbesvik[4], Matthias Koesling[4], and Paul Steinar Valle[5]

[1]Norwegian Agricultural Economics Research Institute
[2]Eastern Norway Research Institute
[3]National Institute for Consumer Research
[4]Norwegian Centre for Ecological Agriculture
[5]The Norwegian School of Veterinary Science
Corresponding author: gudbrand.lien@nilf.no

Abstract

The objective of this exploratory study was to provide empirical insight into how different categories of farmers perceive and manage risk. The data originate from a questionnaire of dairy and crop farmers in Norway. The associations between part-time/full-time farming and farm and farmer characteristics, farmers' goals and future plans, risk perceptions and risk management responses were examined with simple t- and chi-square tests, as well as with logistic regression. The results indicate that full-time and part-time farmers' goals, risk perceptions and management strategies differ significantly. Policy makers and advisers should consider these differences when developing policies and recommendations for the different types of farmers.

Key words: Risk, part-time farming, questionnaire, multivariate analysis, Norwegian agriculture

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Introduction

An increasing number of Norwegian farm families have off-farm employment. In 2002, about 61 percent worked off-farm. Norwegian farms are small compared with those in many developed countries and farm income represents on average, a relatively small and decreasing part of the farm-family household income. In 2001, only 23 percent of the average total household income (for holder and spouse/cohabitant) came from agriculture, forestry and fishing. By contrast, in 1992, the income from the primary industries amounted to 27 percent of total household income (Statistics Norway). Similar developments are found in many developed countries (e.g., Hill; Andersson, Ramamurtie, and Ramaswami). For example, Mishra et al. reported that more than 94 percent of U.S. total farm household income was derived from off-farm sources in 2000, up from 62 percent in 1987.

Studies within a wide range of approaches and disciplines have examined characteristics and motivations that explain part-time and full-time farming. A number of studies examining time allocation in farm households have adapted theory from "new household economics" (Becker) to the special case of the agricultural household model (e.g., Huffmann). Results of these studies include: 1) the characteristics of those participating in off-farm employment and the factors affecting labor supply (hours worked) in off-farm activities (Weersink, Nicholson, and Weerhewa; Woldehanna, Oude Lansink, and Peerlings); 2) the association between education and off-farm work (e.g., Huffman); 3) the effect of differences in and variability of incomes/wealth between agriculture and other occupations (e.g., Mishra and Goodwin; Andersson, Ramamurtie, and Ramaswami; Fall and Magnac); 4) whether part-time farming is a stable adjustment, a way to full-time farming or way out of agriculture (e.g., Kimhi); and 5) survival strategies and diversification on marginal farms (Meert et al.).

Combining part-time farming activities with wage labor is a diversification strategy that may contribute more than on-farm diversification to household income stability. Studies of Norwegian farming households indicate that consumption is more affected by wage than farming income (Sand). Similar results are shown for other countries and for the relation between wage income and business income in general (e.g., Carriker et al.).

Part-time and full-time farmers are to different degrees, financially dependent on farming income. Because the two groups have chosen different livelihood strategies, it seems likely that there will be differences in their perceptions of risk in farming and how they cope with it. Information is lacking about farmers' risky environment and their reactions to it, and especially about differences between part-time and full-time farmers. Some studies (e.g., Wilson, Dahlgran, and Conklin; Martin; Patrick and Musser; Meuwissen, Huirne, and Hardaker; Hall et al.) have examined how farmers in general perceive and manage risk. The empirical relationships between risk attitudes, management and part-/full-time farming choices have not, as far as we know, been explored in earlier studies.

Policy makers, farm advisers and researchers need more practical insights into the likely differences between full-time farmers and the large number of part-time farmers in order to be able to provide better advice and to develop more sharply targeted policies. This exploratory and descriptive study aims to fill part of this gap by providing recent empirical information about part-time/full-time farmers' characteristics, including risk perceptions and responses, but also farm and operator characteristics, and farming goals.

Conceptual Framework

Many studies have been carried out as bases for testable hypotheses about differences between part-time and full-time farmers. For example, results show that part-time farmers are younger, have higher education and smaller farms (e.g., Mishra and Goodwin; Woldehanna, Oude Lansink, and Peerlings). However, examinations of differences between part-time and full-time farmers' perceptions and management of risk are virtually absent in earlier comparative studies, which makes it hard to develop firm hypotheses. An exploratory approach was considered appropriate as research design in this study, though certainly not as a replacement for testable hypotheses.

Van Raaij's model of the firm's decision-making environment is useful to study the relationship between farm and personal characteristics, risk perceptions and management responses (e.g., Wilson, Dahlgren, and Conklin). Van Raaij's model is a framework for research on economic behaviour, where the perceived economic environment determines the individual's economic behaviour with subjective well-being as its consequence.

Figure 1 presents the groups of variables used in our research design. First, P→E/P describes how farm, farmers' goals and other personal variables (P) impact farmers' perceptions of risk factors (E/P). Second, the relationship P→E/P→B reflects how the farm/personal variables and risk perceptions influence economic behaviour (B), i.e., their risk management strategies. Off-farm work is a personal characteristic (i.e., P), but is also a strategy to cope with risk (i.e., B). As pointed out by Wilson, Dahlgren and Conklin, a personal variable (e.g., part-time vs. full-time farming) influences economic behaviour (e.g., risk management). However, the off-farm risk management decision also alters the personal characteristics. In other words, the impact may also be P↔E/P↔B, and it is often impossible to prove which way the causation flows.

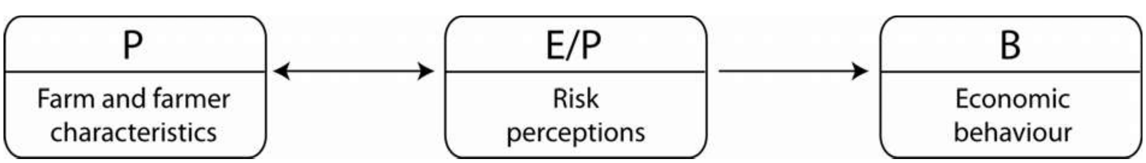

Figure 1. Elements of Van Raaij's model of a firm's decision-making environment

Within this framework, a range of possible empirical differences between part-time and full-time farmers can be explored, and the results may generate hypotheses for future research. A difference that may be explored is if independence in their work is expected to be a more important goal for full-time than part-time farmers. And since the two groups of farmers have different livelihood strategies, part-time farmers may rank the strategy "off-farm diversification" higher than full-time farmers. Further, since part-time farmers receive part of their income off-farm, farm income stability may be less important to them than to full-time farmers. These examples illustrate the wide range of issues that can be explored in our empirical analysis within this research design.

Materials

The data reported here were collected as a part of a larger questionnaire of risk and risk management in farming. The Norwegian Agricultural Authority (SLF) has a register of farmers who receive support payments, which include the total population of farmers in Norway. Based on the 2001 applications, there were more than 17,800 dairy farmers (including 325 organic) and more than 15,600 crop farmers (202 organic). From this SLF register, 850 crop and 862 dairy farmers were sampled. Conventional farmers were selected using simple random sampling, while all organic dairy and crop farmers received the questionnaire. The survey was sent out in January 2003. We were informed that 34 of these farmers had quit farming, reducing the number of possible respondents to 1,678. After two reminders, 1,033 farmers returned the questionnaire for an effective response rate of 62%[1].

Because of small herd sizes in Norway, dairy farms were defined as having more than five dairy cows. Crop farms were defined as having more than 1 hectare (ha) grain, or more than 0.5 ha of potatoes, or more than 0.2 ha of intensive crops (vegetables, fruit, or berries). Dairy farms that also met the cropping criteria were specifically excluded from the crop group.

The survey consisted of questions related to: 1) farmers' perceptions of sources of risk; 2) farmers' perceptions of various risk management strategies; 3) farmers' goals and future plans; and 4) characteristics of the farm and farmer. Most questions were of the closed type, many in the form of seven point Likert-type scales. The questionnaire was pre-tested in sessions with farmers, and refined over several stages based on the comments and suggestions received.

The distinction between full-time and part-time farmers was based on a question that asked respondents if the holder and the spouse (cohabitant) were employed off-farm. If yes, they were asked to report their percentage of off-farm position(s). In the analysis, we have chosen to define a part-time farm as a holding where a single farmer (i.e. unmarried or non cohabitant) or a farmer and the partner have at least a 15 percent off-farm work position. By this classification, we have defined 'dual career' households as full-time farm, for example, when one partner has a less than 15 percent position off-farm and the other works full-time off-farm. After deleting all respondents that failed to answer the part-time question, we were left

[1] The sampling strategy used, the high response rate and the weighting schemes used (see below) imply that the samples should be representative for the farmer populations. Note, however, that the non-respondents (38%) may introduce selection biases in the analysis of the questions, which are not accounted for in results presented.

with 394 crop farms (169 full-time and 225 part-time farms) and 467 dairy farms (386 full time and 81 part time).

Respondents with off-farm work were asked to score six reasons for off-farm work on a Likert-type scale from 1 (not important) to 7 (very important). From a list of 14 farming goals ranging from profit maximization to social contact, the respondents were asked to select up to five as most important. The farmers also indicated their future plans for their holding (within a five-year perspective), by selecting one or several of nine options (such as no changes, downsize, exit or expand).

The survey presented 33 sources of risk for dairy farmers and 25 risk management strategies. Similarly, crop farmer respondents considered 22 sources of risk for crop and 23 risk management strategies. Farmers were asked to score each source of risk on a Likert-scale from 1 (no impact) to 7 (very high impact) to express its potential impact on their farm's economic performance. Farmers also indicated their perceived importance of each risk management strategy on a Likert-scale from 1 (not relevant) to 7 (very relevant).

Additional information about the production systems was obtained through merging the questionnaire survey data with two available databases: the SLF-register of farmers' support payments which includes each farmer's stocking and cropping details and the dairy cow health and production records registered in the Norwegian Herd Recording System.

The analyses were carried out separately for dairy and crop farmers mainly because part-time dairy farmers inevitably have a heavier daily on-farm workload than part-time crop farmers. While the majority of crop producers combine farming with off-farm work, there are fewer part-time dairy farmers. Because combining off-farm occupation with farm work will probably have widely different implications for dairy and crop operations, the division was made to enable the differences to be highlighted.

Methods

Data examined in this study were collected as part of a larger survey among Norwegian farmers (Koesling et al.; Flaten et al.). Organic farmers were heavily over-represented in the sample versus their actual share of Norway's population. Further, our survey sample was not completely representative of the regional and farm size distribution of Norwegian dairy and crop farming. In all analyses, the survey data were weighted with respect to organic/conventional farming systems, regions and farm size, to give results that are as representative as possible for dairy and crop farming in Norway.

As the first step of the analysis, farmers' and farm characteristics, goals, risk perceptions, and strategies were summarized and compared. Mean values obtained for part-time and full-time farmers were compared by standard t-tests for metric (quantitative) variables and chi-square tests for nonmetric (qualitative) variables. Strictly speaking, Likert-type scales are ordinal. In this study, a cardinal interpretation was undertaken. The scale was treated as a continuous variable (Hair et al.; Spicer), making it possible to use standard parametric (multivariate) statistical procedures (e.g., Patrick and Musser; Meuwissen, Huirne, and Hardaker).

Any combined effect of variables that may reflect differences in characteristics between part-time and full-time farmers may be overlooked in bivariate analyses (Spicer). We used regression analysis to gain a more complete picture of differences between part-time and full-time farmers in goals, risk sources, and risk management strategies (figure 1). Data reductions techniques were used to reduce the numbers of factors in the regressions (Hair et al.).

We used common factor analysis to summarize the information about risk perceptions and risk management strategies in a reduced number of factors/variables. Factor analysis also reduced multicollinearity problems in subsequent regressions. Factor solutions with different numbers of factors were examined before structures were defined, in order to have the most representative and parsimonious set of factors (Hair et al.). Orthogonal (varimax) rotation was used to obtain factor solutions that were easier to interpret. Standardized factor scores for each farmer and factor were saved for subsequent multivariate analyses.

Some 20-40% (depending on the group) of the respondents did not answer one or more relevant questions about sources of risk or management responses. In cases with missing data, most of the respondents failed to answer only a few items. If remedies for missing data are not applied, any observations with missing values are omitted. Using only complete observations can produce bias in the results unless observations are missing completely at random. There is also a loss of precision as the sample size is reduced (Hair et al.). To deal with missing data, in the factor analyses we deleted a few cases lacking more than 40% of the risk source variables or 50% of the risk management strategies variables. For the rest, missing data points were replaced with the mean value of that variable based on all valid responses in the group (dairy or crop).

Associations between part-time and full-time farmers (dependent variables) and independent variables were analyzed using binary logistic regressions. Independent variables included farm and farmer characteristics, goals and future plans, in addition to the standardized scores obtained from the factor analyses of risk sources and risk responses. No multicollinearity problems were detected in the regression models. The logistic regression models were complete, but to save space, only the significant variables are reported.

Motivations for Off-Farm Work

The most important motivations for off-farm work, independently of crop or dairy farming system, were to increase the total household income and to get a more reliable and stable income, both with average scores of about 6.3 (figure 2). These results are in accordance with a comparative study of dairy farm families in New York, and Ontario (Weersink, Nicholson, and Weerhewa). The Weersink, Nicholson, and Weerhewa study supports our results that social contact was not among the main motivations for working off-farm. Barlett also found that the main reason for off-farm work was in response to the higher variability associated with farm income.

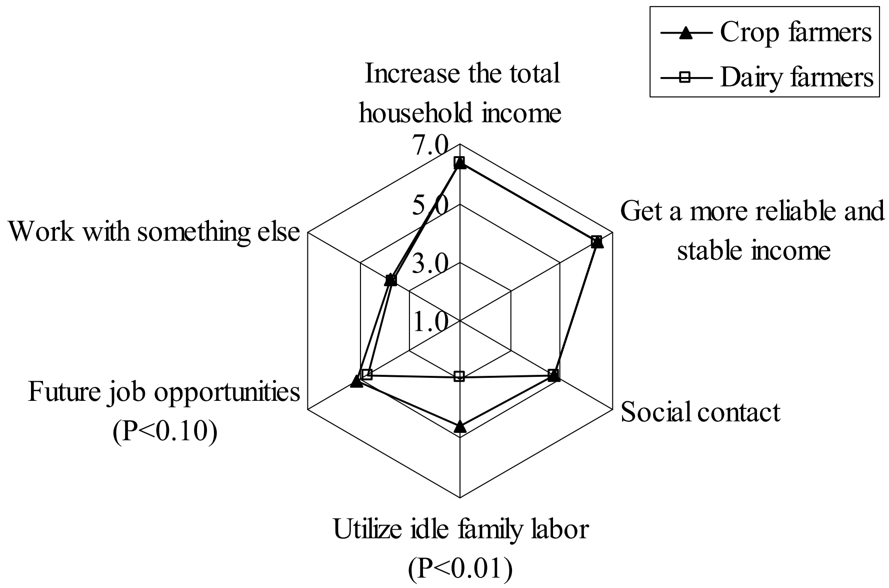

Figure 2 Part-time crop (n = 225) and dairy (n = 81) farmers' main reasons for off-farm work. Weighted average score of responses ranking for each reason. Significance level in parenthesis, based on independent samples t-test between crop and dairy farmers. Values are from a Likert-type scale with 1 being least important and 7 the most important.

There were, however, differences in motivation between dairy and crop farmers, the latter ranked both future job opportunities ($P<0.10$) and utilizing idle family labor ($P<0.01$) significantly higher than dairy farmers. The differences may be related to the large amount of labor required in a dairy operation throughout the year, so that the enterprise does not lend itself so well to part-time farming. Cropping operations, in contrast, are more seasonal. The need to do something other than farming scored low as a motivational factor in both farming systems.

Descriptive Analysis

Key Farmer and Farm Characteristics

Table 1 compares the main farmer and farm characteristics and shows that there are significant differences. Compared with full-time dairy farmers, for example, part-time dairy farmers were younger ($P<0.001$), worked less on the farm ($P<0.05$), had more years of schooling ($P<0.001$), and the main farm operator was more frequently a woman ($P<0.01$). Part-time crop farmers were younger ($P<0.001$), than their full-time colleagues, were more frequently unmarried ($P<0.01$), spent significantly less time working on the farm ($P<0.001$), had more general education, but less frequently received agricultural education ($P<0.01$), and had less farmland ($P<0.01$). Part-time crop farmers had less land in potatoes, vegetables, fruits and berries than full-time crop farmers ($P<0.01$). These results are consistent with previous studies (e.g., Mishra and Goodwin; Woldehanna, Oude Lansink, and Peerlings).

Table 1 Weighted average farmer and farm characteristics for full-time and part-time dairy and crop farmers[1)]

Farmer and farm characteristics	Dairy Full time	Dairy Part time		Crop Full time	Crop Part time	
Number of farms	386	81		169	225	
Age of the farmer[2)]	48.1	43.0	***	52.8	47.6	***
Marital status (% married)	84	86		90	78	**
Farm labor units (man-years)	2.06	1.84	*	1.41	0.65	***
Education, BS or higher (%)	9	23	***	26	44	***
Agricultural education (%)	57	55		61	47	**
Management responsibility (%)[3)]	5/73/22	12/76/12	**	7/72/21	7/80/13	
Location (%)[4)]	26	19		61	65	
Farmland (ha)[2)]	22.7	21.5		24.3	18.3	**
Potatoes, veg., and fruit (% of farmland)				9	4	**
Number of dairy cows[2)]	14.5	13.4				

1) Weighted average farmer and farm characteristics marked with asterisks show that the characteristics of full-time and part-time dairy and crop farmers, respectively, are significant different at (*)$P<0.10$, *$P<0.05$, **$P<0.01$, and ***$P<0.001$, based on independent samples t-test (for metric values) and chi-square-test (for non-metric values).
2) Data (2002) from the Norwegian Agricultural Authority.
3) Principal person(s) in charge for farm management: woman, man, split between two or more persons.
4) Measured as a dummy variable where 1 denotes central location and 0 denotes otherwise

Farmers' Goals

Full-time farmers ranked producing high-quality food as the most important goal and reliable and stable income second (table 2). Part-time dairy farmers ranked reliable and stable income first and having time for the family second. Unlike dairy farmers, part-time crop farmers differed less from full-time farmers. Instead of income stability, however, part-time crop farmers ranked the goal to improve the farm for the next generation as the second most important. Producing high quality food was more important for full-time than for part-time dairy farmers ($P<0.001$). As expected, "independence" was ranked higher by full-time than part-time crop farmers ($P<0.05$). Sustainable and environmentally sound farming (landscape preservation included) was ranked higher among part-time farmers than among both full-time dairy ($P<0.01$) and crop farmers ($P<0.10$). It seems that part-time farmers are concerned about preserving the landscape, but perhaps full-time farmers do so unconsciously. The data also show an association between education level (which is highest among part-time operators) and the importance assigned to environmental issues.

Profit maximization was ranked rather low by all groups of respondents. However, on average, part-time farmers ranked this goal somewhat higher than full-time farmers, and significantly ($P<0.05$) so in dairy production. One reason may be that part-time farmers have a higher opportunity cost of farm labor than full-time farmers. Faced with low farm incomes, the part-time farmer may be inclined to work more off-farm.

In our study, having a reliable and stable farm income was less important for part-time than full-time crop farmers (*P*<0.10). We also found that stable income was more important for dairy than crop farmers. This may be because dairy farmers have more control over the production process since cropping is more dependent on weather and growing conditions. Risk-averse farmers also may choose to go into dairying rather than cropping, since more stable income is obtained from dairying.

Table 2 Weighted percentage of responses ranking each goal among the top five[1)]

Farmers' goals	Dairy				Crop				
	Full time	Part time		Rank P t.[2)]	Full time	Rank F t.[2)]	Part time		Rank P t.[2)]
Produce high quality food	68	46	***	3	60	1	55		1
Reliable and stable income	66	70		1	56	2	48	(*)	4
Independence	49	43		4	45	4	34	*	6
Time for family, living quality for children	43	51		2	42	5	49		3
Improve the farm for next generation	33	41		6	46	3	54		2
Have possibility to some leisure	30	27		9	13	11	11		11
Sustainable and env.-sound farming	27	43	**	4	37	6	45	(*)	5
Reduce debt, become free of debt	24	29		8	18	10	24		7
Continue to be a farmer	22	31	(*)	7	30	7	24		7
Work with animals/crops	20	22		11	20	9	17		10
Maximize profit	17	27	*	9	21	8	24		7
Increase equity	3	1		13	8	12	4		13
Social contacts	2	5	***	12	2	13	6	(*)	12
Higher private consumption	1	1		13	1	14	3		14

1) Weighted percent of responses for each goals marked with asterisks show that the goals of full-time and part-time dairy and crop farmers, respectively, are significant different at (*)*P*<0.10, **P*<0.05, ***P*<0.01, and ****P*<0.001, based on chi-square-test. Ranked by decreasing importance for full-time dairy farmers.
2) Ranking by part-time (P t.) dairy farmers (column five), full-time (F t.) crop farmers (column seven) and part-time (P t.) crop farmers (column ten), respectively

Our results support earlier studies (e.g., Bergevoet et al.; Gasson et al.; Willock et al.) reporting that farmers have several goals, and see farming as more than a way to make money.

Perceptions of Risk Sources

Table 3 shows the rating of risk sources and whether they differ significantly among the groups. The risk sources are presented in order of decreasing importance for full-time dairy farmers. All groups ranked institutional risks (such as uncertainty about the continuation of government support payments, changes in the dairy quota system, or changes in tax policy) as important sources of risk. The importance of institutional risks may reflect the somewhat unpredictable changes in Norwegian farm policies and regulations, together with external pressures for deregulation and associated fears of farm support cuts. The finding also should be linked to Just's proposal that longer-term swings (e.g., lasting changes in agricultural policy) represent a much greater risk to farmers than year-to-year variability in payoffs. Only the downside consequences of long-term changes are likely that to be sufficiently prolonged to cause farm failure. A Finnish study also found that changes in agricultural policy were the most important risk source for farmers (Sonkkila).

Table 3 Weighted mean score1) and t-tests for full-time and part-time dairy and crop farmers for sources of risk[)]

Risk sources[2)]	Dairy				Crop				
	Full time	Part time		Rank P t.[3)]	Full time	Rank F t.[3)]	Part time		Rank P t.[3)]
Changes in government support payments	5.92	5.70		2	5.31	4	5.58	(*)	3
Changes in tax policy	5.80	5.71		1	5.43	3	5.62		2
Milk price variability	5.79	5.53		3					
Milk quota policy	5.53	5.19	(*)	8					
Animal welfare policy	5.49	4.70	***	11					
Meat price variability	5.47	5.41		4					
Changes in consumer preferences	5.20	5.20		7	5.28	5	4.75	***	7
Injury, illness, death of operator(s)	5.11	5.24		6	4.93	8	4.29	***	10
Cost of operating inputs	5.11	5.40		4	4.97	7	4.85		5
Non-domestic epidemic animal diseases	5.01	5.02		9					
Domestic epidemic animal diseases	4.97	4.89		10					
Forage yield uncertainty	4.90	4.34	**	16					
Other government laws and regulations	4.74	4.65		12	4.57	9	4.53		8
Fire damages	4.67	4.43		15	4.00	14	3.69		14
Cost of capital equipment	4.64	4.48		14	4.54	10	4.45		9
Technical failure	4.52	4.20		20	4.27	11	4.06		11
Meat production variability	4.35	4.29		19					
Changes in technology	4.34	4.09		23	3.79	15	3.94		12
Marketing/sale	4.32	4.34		16	5.10	6	4.79	*	6
Legislation in production hygiene	4.32	3.91	(*)	25					
Production diseases	4.32	3.55	***	27					
Cost of credit (interest rate)	4.27	4.34		16	3.52	16	3.84	(*)	13
Crop prices variability	4.26	4.10		21	5.98	1	5.96		1
Family member's health situation	4.21	4.10		21	4.19	12	3.32	***	15
Crop yields variability	4.14	4.49		13	5.71	2	5.48		4
Milk yield variability	4.13	4.00		24					
Hired labor cost and availability	3.73	3.54		28	3.12	18	2.57	**	20
Credit availability	3.52	3.56		26	2.95	20	3.14		17
Family relations	3.17	3.15		30	3.05	19	2.85		19
Availability and cost of leased farmland	3.15	3.37		29	3.16	17	3.24		16
Additional organic farming payments	2.73	2.69		31	2.70	21	2.90		18
Organic farming laws/regulations	2.35	2.47		32	2.58	22	2.57		20
Price premiums organic products	2.32	2.38		33	2.42	23	2.51		22

1) Weighted mean score (1 = no dependency, 7 = very high dependency) for full-time dairy farmers, part-time dairy farmers, full-time crop farmers and part-time crop farmers. Weighted mean numbers marked with asterisks show that the mean scores of full-time and part-time dairy and crop farmers, respectively, are significant different at (*)P<0.10, *P<0.05, **P<0.01, and ***P<0.001, based on independent samples t-test.

2) Ranked by decreasing importance for full-time dairy farmers.

3) Ranking by part-time (P t.) dairy farmers (column four), full-time (F t.) crop farmers (column six) and part-time (P t.) crop farmers (column eight), respectively

Price variability was the highest ranked source of risk among crop farmers. Milk price variability was ranked third by dairy farmers. Crop producers ranked crop yield variability higher than dairy producers ranked milk yield variability. Crop yield variability may be of greater importance because output is highly influenced by weather while milk yields are somewhat stable.

All groups ranked availability and cost of hired labor, credit, and leased farmland, as well as family relations and "organic" risk sources (laws and regulations, price premiums, and farm payments low as sources of risk (table 3)). The low score for organic sources is due to the small numbers of organic farmers in Norwegian agriculture.

Full-time dairy farmers rated milk quota policy ($P<0.10$), animal welfare policy ($P<0.001$), forage yield uncertainty ($P<0.01$), legislation in production hygiene ($P<0.10$), and production diseases ($P<0.001$) as more important risk sources than part-time dairy farmers. There was a negative association between risk related to animal welfare policy and increasing education level. The greater importance attached to animal welfare policy by full-time farmers may reflect the higher education level among part-timers.

Full-time crop farmers regarded changes in consumer preferences ($P<0.001$), injury, illness and death of operator(s) ($P<0.001$), marketing/sale ($P<0.05$), family members' health situation ($P<0.001$), and hired labor cost and availability ($P<0.01$) as most important. Some of these findings may reflect the fact that full-time crop farmers do more farm work and had more farmland than part timers. Full-time farmers' incomes also are normally more dependent on farm output than part-time farmers. Further, since the full-time crop producers had more potatoes, vegetables and fruit than their part-time colleagues (table 1), marketing/sales often will be more important. Greater vegetable and fruit production also made full-time crop farmers more dependent on availability of seasonal rented labor and their own health situation in labor-intensive harvesting seasons.

Common factor analysis was applied to the risk source variables of the dairy and crop sub-samples separately (table 3) to reduce the number of variables in subsequent binary logistic regression analyses.

The number of variables for the dairy risk source data was reduced from 33 to six. Some 50.2% of the total variance was accounted for, a satisfactory amount in social sciences (Hair et al.). The factors were labeled: 1) dairy, that loads significantly from a variety of dairy production variables; 2) institutional, consist of a wide collection of public payment and government legislation variables; 3) organic, which has extremely high loadings of the three variables specific for organic farming; 4) human resources, with heavy loadings of health and family variables; 5) credit, with high loadings of the interest rate and credit availability; and 6) market, which involves high loadings of changes in consumer preferences and marketing.

Of the 22 risk sources presented for crop producers, the factor analysis resulted in six factors that explained 56.2% of the total variation. The factors were labeled: 1) institutional, with high loadings for public payments and government variables, and input prices; 2) organic, where the three specific external risks for organic farming had high loading; 3) human resources, includes both health risk of the operator and the family, uncertainty about the family, hired labor and fire; 4) credit, with high loadings for credit cost and availability; 5) crop, with crop prices and crop yields variability having high loadings; and 6) market, involving significant loadings for changes in consumer preferences and marketing. The factor scores from these factor variables were used in subsequent multivariate analysis.

Perceptions of Risk Management Strategies

Having good liquidity, preventing/reducing livestock and crop diseases and pests (for dairy farmers and crop farmers, respectively), buying farm business insurance and personal insurance and producing at lowest possible cost were strategies generally perceived as highly relevant (table 4). In recent studies of farmers in other countries, the same financial management strategies were also perceived among the most important (Meuwissen, Huirne, and Hardaker; Hall et al.; Harwood et al.), even though the national risk environments are different. Farmers in our study generally did not perceive organizing the farm as a corporation, possessing off-farm investments and having surplus machinery capacity as important risk management strategies.

While full-time dairy farmers did not consider off-farm work as an important risk strategy, part-time farmers scored it higher ($P<0.001$). Further, compared to their full-time colleagues, part-time dairy farmers ranked off-farm investments ($P<0.001$), surplus machinery capacity ($P<0.001$), solvency ($P<0.05$), and storage ($P<0.01$) as relatively more important strategies to deal with risk, but ranked buying farm business insurance ($P<0.10$) lower. Also, full-time crop farmers ranked off-farm work low as a risk management strategy, while it was the top-rated strategy for part-time farmers. Full-time crop farmers attached much greater importance than their part-time colleagues to good liquidity ($P<0.05$), use of risk-reducing technologies (irrigation etc) ($P<0.001$), cooperative marketing ($P<0.05$), use of economic consultancies ($P<0.10$), enterprise diversification ($P<0.001$), and use of production contracts ($P<0.001$). Full-time crop farmers might rank risk-reducing technologies and production contracts higher because they produce more vegetables and fruit. On farm diversification was also important for full-time farmers, perhaps since their main source of income is the farm.

Of the 23 risk management strategies presented for the crop producers, the factor analysis identified six factors which accounted for 40.1% of the variance. Labels and interpretations of the crop factors are: 1) consultancy, which includes heavy loadings for consultancy, storage, and joint operation; 2) flexibility, with high loadings for product, market, and asset flexibility; 3) insurance, where farm business and personal insurance dominate; 4) low cost, which includes producing at lowest possible cost, preventing or reducing crop diseases and pests and risk-reducing technologies; 5) financial, including mainly solvency and liquidity; and 6) diversification, which includes mainly off-farm work and joint operations.

Table 4 Weighted mean score[1)] and t-tests for full-time and part-time dairy and crop farmers for risk management strategies

Risk management strategies[2)]	Dairy Full time	Dairy Part time	Dairy Rank P t.[3)]	Crop Full time	Crop Rank F t.[3)]	Crop Part time	Crop Rank P t.[3)]
Liquidity – keep cash in hand	6.44	6.43	1	6.46	1	6.21 *	2
Prevent/reduce livestock diseases	6.33	6.29	2				
Buying farm business insurance	6.08	5.82 (*)	5	6.01	3	5.96	4
Produce at lowest possible cost	5.88	5.93	3	5.87	6	5.89	5
Buying personal insurance	5.84	5.81	6	5.92	5	5.81	7
Risk reducing technologies	5.75	5.51	10	5.74	7	5.24 ***	9
Use of agronomic/nutritional consultancies	5.55	5.53	9	5.16	10	4.95	11
Solvency – debt management	5.49	5.84 *	4	5.94	4	5.89	5
Prevent/reduce crop diseases and pests	5.43	5.71 (*)	8	6.14	2	5.98	3
Small gradual changes	5.36	5.36	11	5.44	8	5.43	8
Cooperative marketing	5.32	5.36	11	4.77	14	4.36 *	17
Use of veterinarian consultancies	5.16	5.06	13				
Shared ownerships of equip., joint operations	4.74	4.75	15	4.52	18	4.59	13
Asset flexibility	4.69	4.78	14	5.36	9	5.18	10
Keeping fixed costs low	4.57	4.50	17	4.56	17	4.49	14
Use of economic consultancies	4.52	4.28	19	4.29	19	3.91 (*)	20
Storage	4.15	4.66 **	16	4.27	20	3.97	19
Enterprise diversification	4.10	4.31	18	4.99	12	4.23 ***	18
Production contracts	4.05	3.65 (*)	23	5.04	11	4.39 ***	16
Collecting information	3.72	3.97	21	4.82	13	4.60	12
Off-farm work	3.67	5.72 ***	7	4.73	15	6.33 ***	1
Surplus machinery capacity	3.31	4.06 ***	20	3.77	21	3.82	21
Product and market flexibility	3.23	3.25	24	4.61	16	4.41	15
Off-farm investments	2.44	3.77 ***	22	3.10	22	3.77 ***	22
Organize the farm as a corporation	2.19	2.60 *	25	2.65	23	2.46	23

1) Weighted mean score (1 = not important, 7 = very important) for full-time dairy farmers, part-time dairy farmers, full-time crop farmers and part-time crop farmers. Weighted mean numbers marked with asterisks show that the mean scores of full-time and part-time dairy and crop farmers, respectively, are significant different at (*)P<0.10, *P<0.05, **P<0.01, and ***P<0.001, based on independent samples t-test.
2) Ranked by decreasing importance for full-time dairy farmers.
3) Ranking by part-time (P t.) dairy farmers (column four), full-time (F t.) crop farmers (column six) and part-time (P t.) crop farmers (column eight), respectively

Common factor analysis was applied to the risk management variables for dairy and crop farmers separately, in order to reduce the number of variables for use in subsequent regressions (table 4). The factor analysis identified seven interpretable and feasible dairy factors, accounting for 44.4% of the variance. Labels and interpretations of the factors are: 1) flexibility, which includes on-farm strategies to enhance flexibility (storage included) and use of price contracts; 2) consultancy, with high loadings for veterinarian, agronomy/nutrition, and economic consultancies; 3) disease prevention, with high loadings of prevention/reduction of pests and diseases in crops/forage and livestock; 4) insurance, which has heavy loadings for insurance contracts; 5) diversification, which includes off-farm investments, off-farm work, on-farm diversification and collecting more information; 6) financial, including financial aspects of the farm business (solvency, liquidity, and production costs); and 7) fixed cost sharing, which has high loadings for shared ownership of equipment and joint operations.

The differences in derived factors for crop and dairy farmers were small. In other words, the crop and dairy farmers seem to use much of the same strategies to manage risk. This finding may indicate fairly similar underlying factor structures among management responses of farmers across the two farm types.

Multivariate Analysis

Table 5 presents significant results from the binary logistic regression for dairy and crop farmers.

Compared to full-time dairy farmers, part-time dairy farmers (at 5% significance level): were younger; were more frequently married/in partnership; gave higher importance to the goals of sustainable and environmentally-sound farming, and to improving the farm for the next generation.

Compared to full-timers, part-time dairy farmers considered downsizing the farm operation as a more important strategic direction; viewed human risk as less important; and considered consultancy, insurance and fixed cost sharing as less important strategies to manage risk. Further, disease prevention, diversification (including off-farm investments, off-farm work, on-farm diversification etc) and financial aspects were more important for part-time than full-time dairy farmers.

Compared to full-time farmers (at 5% significance level), part-time crop farmers were younger, more frequently single; worked less on the farm; invested more off the farm; had a higher household income; regarded the goals of independence and sustainable and environmentally sound farming lower; and planned more frequently to downsize the farm operation and less frequently to diversify with more enterprises over the next five years. They were less concerned about risk sources such as human resources and crop price and yield variability, but more concerned about credit risks. They regarded consultancy as a less important strategy to manage risk than did full-time crop farmers.

In general, there was consistency between the partial statistical analyses and the regression analyses. Unlike the bivariate analyses, the regression analyses showed no significant differences between part-time and full-time dairy farmers' off-farm investment strategy. Further, we found no significant differences between part-time and full-time crop producers' education levels and the importance they assigned to maximizing profit. Surprisingly, the regression results indicated that sustainable and environmentally-sound farming was more important for full-time than part-time crop farmers, the opposite results of the bivariate analysis.

It also is surprising that both groups of part-time farmers plan more frequently to downsize the farm operation, compared to their full-time colleagues. For most farmers, growth, consolidation or exit are the expected options. A Belgian study has, however, found that off-farm employment very rarely led to cessation of agricultural work (Meert et al.). For many part-time farmers, the downsizing option may be necessary to cope with multiple job situations.

Table 5 Dairy and crop farmers, results of multiple logistic regressions. Binary dependent variable is part-time (=1) or full-time farmer (=0)

Independent variables	Dairy		Crop	
	Param.[1)]	Sign.Lev.[2)]	Param.[1]	Sign.Lev.[2)]
Farmer and farm				
Age of the farmer	-0.59	**	-0.47	**
Marital status[3)]	0.90	*	-0.82	*
Education[4)]	0.51	(*)		
Agricultural education[5)]			-0.38	(*)
Farm labor units (man-years)	-0.31	(*)	-0.81	***
Off-farm investment[6)]			0.67	*
Farm income[7)]	-0.30	(*)		
Household income[8)]			0.91	***
Goals[9]				
Maximize profit	0.38	(*)		
Independence			-0.68	**
Sustain. and environmentally-sound farming	0.79	***	-0.54	*
Improve the farm for next generation	0.88	***		
Future plans[9)]				
Downsize the farm operation	0.85	*	0.99	*
Diversify, with one/several farm enterprises			-0.52	(*)
Risk sources[10)]				
Human resources	-0.28	**	-0.31	**
Credit			0.41	**
Crop			-0.33	**
Risk strategies[10)]				
Consultancy	-0.30	*	-0.31	*
Disease prevention	0.35	*		
Insurance	-0.29	*		
Diversification	0.95	***	0.23	(*)
Financial	0.45	**	0.23	(*)
Fixed cost sharing	-0.38	**		
Df	325		276	
Pseudo R^2_{adj}	0.60	***	0.66	***

1) Coefficients for dummy variables are unstandardized, all others are standardized.
2) Variables significant at (*)P<0.10, *P<0.05, **P<0.01 and ***P<0.001. Only significant variable are shown. Parameter estimates for the complete models are available from the authors.
3) Measured as dummy variable where 1 denotes married/partner and 0 otherwise.
4) Measured as a dummy variable where 1 denotes formal schooling beyond secondary school and 0 denotes secondary school education or less.
5) Measured as a dummy variable where 1 denotes agricultural education and 0 denotes otherwise.
6) Measured as a dummy variable where 1 denotes off-farm investments the last five years and 0 denotes otherwise.
7) Measured as a dummy variable where 1 denotes farm income ≥ NOK 100 000 (≈ US$ 14 700) and 0 denotes otherwise.
8) Measured as a dummy variable where 1 denotes household income ≥ 350 000 NOK and 0 otherwise.
9) Measured as a dummy variable where 1 denotes the farmer mentioned the goal or future plan as important and 0 denotes otherwise.
10) Factor score variables from the factor analysis for each farmer are used.

There are several explanations for the finding that younger farmers participate more frequently in the off-farm labor market. One is that entering farmers often have an off-farm education and experience before taking over the farm. An extra job may also contribute to financing farm investments (Meert et al.), and younger farm families can often get help on the farm from the older generation (Jervell). The age differences between part-time and full-time farmers may also indicate, however, that younger farmers increasingly expect to combine farming and off-farm work (table 1).

Conclusions

There is little published information about differences in how part-time and full-time farmers perceive and manage risk. This study revealed that full-time and part-time farmers' goals, risk perceptions and risk management strategies differ significantly. Further, compared to full-time farmers, part-time farmers plan more frequently to downsize their farm operations, which may be a necessity to cope with multiple job situations. Policy makers and advisers should consider the differences in goals, management and risk characteristics between part-time and full-time farmers when developing policies and recommendations. That part-time farmers different from full-time farmers, for example, consider off-farm work as a highly relevant strategy to cope with risk and to obtain a more reliable and stable income as an important motivation for off-farm work are important in that connection. We could then expect farm-income stabilization to be of less concern for part-time than for full-time farmers, but the two groups do not differ significantly in their perceptions of government payments and output price risks. Advisers should distinguish between part-time and full-time farmers, since, e.g., the first group may consider on-farm diversification less important.

Since the results showed that several risk factors are important to all farmers, it would be helpful if those advising farmers could provide more and better information to enable their clients to make better-informed judgments about the risks they face. Also, farm management consultants and advisers should make greater use of modern decision analysis tools that incorporate the main sources of risk.

Acknowledgements

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Vedlegg 9

Forskningsnytt om økologisk landbruk i Norden nr. 2/2004

Hel- og deltid i økologisk melkeproduksjon

Det er interessante forskjeller mellom hel- og deltidsbrukere som driver økologisk melkeproduksjon. Deltidsbrukere er yngre og har høyere utdannelse enn heltidsbrukere. Det er viktigere for deltidsbrukerne å intensivere driftsenheten og øke arealet enn å drive miljøvennlig og bærekraftig, mens det motsatte er tilfelle for heltidsbrukerne.

Flere og flere bønder er deltidsbrukere. Dette gjelder også de økologiske driftsenhetene. Trenden i Norge er at inntektene fra jordbruket utgjør en mindre del av gårdbrukerfamiliens totale inntekt. I 2001 var den totale familieinntekten 372 400 Nkr. Av disse utgjorde inntekter fra jordbruk, skogbruk og fiske 23 %. I 1992 var denne prosentandelen 27 %.

Det er gjort flere undersøkelser for å finne typiske trekk ved heltids- og deltidsjordbruk og motiver for valg av driftsform. Siden heltids- og deltidsjordbrukere i ulik grad er avhengige av inntjening fra gården, og siden de to gruppene har valgt forskjellige strategier for livsopphold, kan det også tenkes at det er ulikheter mellom gruppene i oppfatelsen av risiko og hvordan de håndterer risiko. Disse aspekter, som tidligere ikke har blitt belyst i litteraturen, er hovedtema for denne studien.

Spørreundersøkelse om risiko og risikohåndtering

Resultatene i denne artikkelen ble samlet i 2003 gjennom en større spørreundersøkelse om risiko og risikohåndtering, som blant annet ble sendt til alle økologiske melkeprodusenter. Svarprosenten var 62 %. Gårder med færre enn 5 melkekyr var ikke med i undersøkelsen. Deltidsbruk definerte vi som driftsenheter der bonden (og eventuelt partneren) hadde minst 15 % arbeid utenfor bruket. Etter å ha fjernet bruk som ikke svarte på "deltids-spørsmålene", var det 145 økologiske melkeproduksjonsbruk igjen. 117 av disse var heltidsbruk og 28 deltidsbruk.

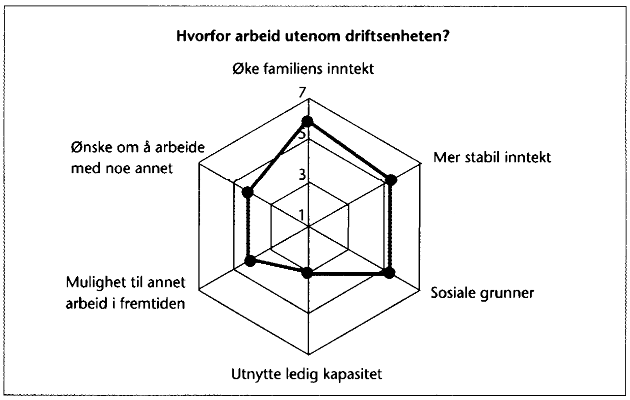
Spørreundersøkelsen er en del av et større forskningsprosjekt som finansieres av Norges Forskningsråd og som er et samarbeid mellom Norsk institutt for landbruksøkonomisk forskning (NILF), Norsk senter for økologisk landbruk (NORSØK) og Norges veterinærhøgskole (NVH).

Ulikheter mellom heltids- og deltidsbruk

På mange av spørsmålene i undersøkelsen skulle det svares på en Likert-skala fra 1 til 7. Svarene ble summert og gjennomsnittsverdier for heltid- og deltidsbrukere ble sammenlignet ved hjelp av standard *t*-test og kji-kvadrat test. Hovedresultatene er gjengitt i tabellen.

Bøndene som driver økologisk melkeproduksjon på deltid var yngre og hadde høyere utdannelse enn heltidsbrukerne. Blant deltidsbrukerne var det en tendens til at flere kvinner hadde driftsansvaret og færre var gift eller samboere. Arealet var større på heltidsbrukene, de hadde flere årskyr og dyrker mer korn *(sv. spannmål)*. For heltidsbrukerne var inntekten fra jordbruket høyere enn hos deltidsbrukerene. Det var derimot ingen statistisk signifikante forskjeller mellom gruppene når det gjaldt melkeavdrått, kraftfôrforbruk per 100 kg melk og celletall.

Det var viktigere for heltidsbrukerne enn for deltidsbrukerne å ha et selvstendig arbeid, drive miljøvennlig og bærekraftig og å redusere gjeldsnivået. Det var også en tendens til at flere av dem hadde en målsetning om å produsere mat av god



Figuren viser at for økologiske deltidsbruk med melkeproduksjon var det å øke familiens inntekt den viktigste årsaken til å arbeide utenom bruket. Deretter kom mer stabil inntekt og sosiale grunner. Utnytting av ledig arbeidskapasitet var den minst viktige årsaken til å arbeide utenfor driftsenheten.

Variabel	Heltidsbrukere	Deltidsbrukere	Forskjell[1]
Bondens alder, år	48	44	*
Kvinne ansvarlig for drift %	4	14	(*)
Sivilstand, % gift/samboer	96	82	(*)
Høgskole eller høyere, %	38	54	(*)
Næringsinntekt > 100.000 %	82	68	(*)
Total areal, daa	318	249	*
Kornareal, daa	46	19	*
Antall årskyr	16,7	13,6	*
Kg melk per årsku	5152	5030	
Kraftfôr per 100 kg melk	0,17	0,17	
Celletall (geometrisk middel)	122,8	136,8	
Bøndenes målsetninger[2]			
Ha et selvstendig arbeid %	45	18	**
Størst mulig totalinntekt %	8	21	*
Drive miljøvennlig og bærekraftig %	77	57	*
Mindre gjeld, bli gjeldsfri %	24	7	*
Produsere mat av god kvalitet %	74	57	(*)
Intensivere driftsmåten %	3	11	(*)
Kjøpe/leie tilleggsjord %	26	43	(*)
Risikokilder[2]			
Usikkerhet om fremtidig regelverk for produksjonshygiene %	38,5	46,8	*
Usikkerhet om fremtidig regelverk for dyrevelferd %	41,1	49,6	(*)
Usikkerhet vedr. lånerente %	40,3	33,9	(*)
Tiltak for å redusere risiko[2]			
Arbeide utenom driftsenheten %	35,4	55,4	***
Investere utenom driftsenheten %	23,1	36,1	***
Bruk av økonomisk rådgivning %	40,0	46,8	(*)

1) Signifikante forskjeller vises på følgende nivåer: (*)= p<0.10, * =p<0.05, ** =p<0.01 og *** = p<0.001.
2) Det er bare tatt med utsagn som ga signifikante forskjeller mellom hel- og deltidsbruk.

Tabell. Gjennomsnitt for ulike variabler og forskjeller mellom hel- og deltidsgårder med økologisk melkeproduksjon.

kvalitet. En større andel av deltidsbrukerne hadde som mål å få størst mulig inntekt, intensivere driftsenheten og leie/kjøpe mer areal.

Usikkerhet om fremtidig regelverk for produksjonshygiene bekymret deltidsbrukerne mer enn de som driver heltidsbruk. Den samme tendens syntes å være tilfellet for usikkerheten om fremtidig regelverk for dyrevelferd. Usikkerhet vedrørende lånerenten ansåg derimot heltidsbrukerne som en større risikokilde enn deltidsbrukerne.

De viktigste tiltakene for å redusere risikoen på deltidsbrukene var å arbeide og investere utenom driftsenheten. Det var også en tendens til at deltidsbrukerne i større grad enn heltidsbrukerne benyttet økonomisk rådgivning. ■

Martha Ebbesvik[1] (tlf. + 47 71 53 20 09; e-post: martha.ebbesvik@norsok.no), Gudbrand Lien[2], Matthias Koesling[1], Ola Flaten[2] og Paul Steinar Valle[3]
1) NORSØK 2) NILF 3) NVH

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UUSI KIRJALLISUUS

Lättillgängligt om ekosystemtjänster

"Framtidens jordbruk – en skrift om ekosystemtjänster" förklarar enkelt i text och bild vad ekosystemtjänster är och hur vi bör utforma jordbruket för att på bästa sätt gynna och dra nytta av ekosystemtjänsterna. Skriften innehåller också en diger referenslista för den som vill fördjupa sig i ämnet. Texten är skriven av Kristina Belfrage som är doktorand vid institutionen för landsbygdsutveckling, SLU. Utgivare är Centrum för uthålligt lantbruk (CUL). ■

Kristina Belfrage
Framtidens jordbruk – en skrift om ekosystemtjänster
2004. Centrum för uthålligt lantbruk (CUL), SLU.
24 sidor, A5.
Beställs kostnadsfritt från Kristina Torstensson, e-post: Kristina.Torstenson@cul.slu.se, tel: +46 (0)18 67 20 92.

Vedlegg 10

Stochastic utility-efficient programming of organic dairy farms [*]

Ola Flaten and Gudbrand Lien
Norwegian Agricultural Economics Research Institute
Corresponding author: ola.flaten@nilf.no

Abstract

Opportunities to make sequential decisions and adjust activities as a season progresses and more information becomes available characterise the farm management process. In this paper, we present a discrete stochastic two-stage utility efficient programming model of organic dairy farms, which includes risk aversion in the decision maker's objective function as well as both embedded risk (stochastic programming with recourse) and non-embedded risk (stochastic programming without recourse). Historical farm accountancy data and subjective judgements were combined to assess the nature of the uncertainty that affects the possible consequences of the decisions. The programming model was used within a stochastic dominance framework to examine optimal strategies in organic dairy systems in Norway.

Keywords: Agriculture; Risk analysis; Stochastic programming; Stochastic dominance; Organic farming

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1. Introduction

In stochastic programming some of the data elements incorporated into the objective function or constraints are uncertain (Kall and Wallace, 1994; Dupačová, 2002). Many mathematical programming studies including risk in agricultural economics have adopted a static framework and included risk aversion in the decision maker's objective function. The most widely used techniques have been quadratic risk programming (Markowitz, 1952; Freund, 1956) and its linear approximations such as MOTAD (Hazell, 1971). For the farmer, the main issue raised by variability of price and production is how to respond tactically and dynamically to opportunities or threats to generate additional income or to avoid losses (i.e., how to respond after the outcome of a random variable is observed) (Pannell et al., 2000). Some studies of conventional farming systems have used stochastic programming with recourse to deal with this aspect (e.g., Kaiser and Apland, 1989; Kingwell, 1994; Torkamani and Hardaker, 1996; Pannell and Nordblom, 1998; Lien and Hardaker, 2001; Torkamani, 2005).

Compared to conventional farming, organic farming systems are subject to different and perhaps higher exposure to risk due to restrictions on use of pesticides, soluble mineral fertilizers, synthetic medicines, purchase of feeds and livestock, etc. Additionally, smaller organic markets may mean greater price fluctuations. But, as far as we know, only deterministic linear programs have been used as decision support models for organic farmers (e.g., Berentsen et al., 1998; Pacini et al., 2004).

In this paper we present a stochastic utility-efficient programming model of organic dairy farms. The model is applied to a Norwegian case farm to examine optimal farming systems under prevailing economic conditions, as well as under a constructed scenario with greater farm income variability. Compared to previous studies, the model includes two methodological advances:

- An organic dairy system is modelled in a whole-farm context that includes risk aversion in the decision maker's objective function as well as both embedded risk (stochastic programming with recourse) and non-embedded risk (stochastic programming without recourse).
- It illustrates how a stochastic programming model can be used within a stochastic efficiency framework (Hardaker et al., 2004b) to rank risky farm strategies and assess policy questions under risk.

2. The model

Our two-stage model incorporates both non-embedded risk and embedded risk, as outlined in Fig. 1. We assume a one-year plan starting in spring. First-stage decisions are, e.g., how many cows and heifers to keep, allocation of land to various crops, and the use of manure from the previous indoor season. The nature of biological production implies yield uncertainty. Since dairy farmers do not perceive milk yield as an important source of risk (Flaten et al., 2005) and because of strict rules about livestock trade in organic farming, possible adjustment to cow numbers etc. to match the milk quota, is not included in the model. Therefore, once the numbers of cows and heifers are decided, the dairy herd size is fixed. The risk associated with the dairy herd is thus non-embedded risk, as indicated by the upper branch of Fig. 1.

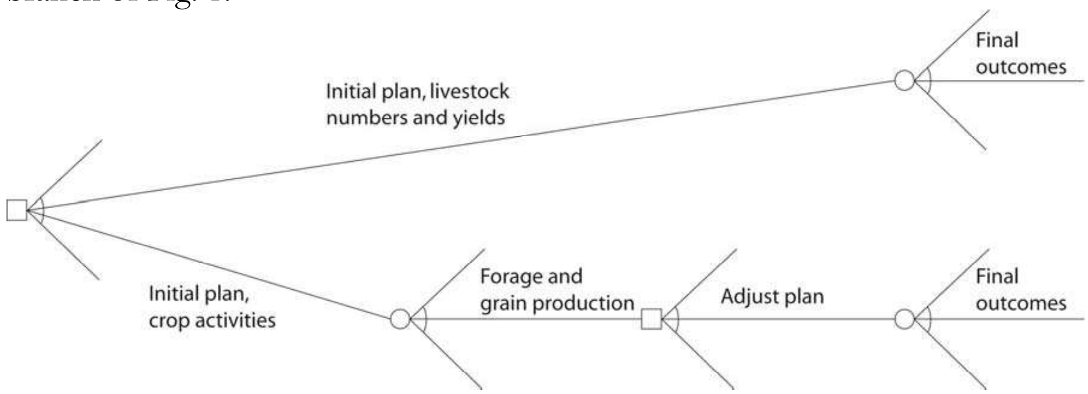

Fig. 1. Outline decision tree for our problem.

Uncontrollable factors (weather, pests, unpredictable biological processes, etc.) imply crop yield uncertainty, with the actual yields being known only after harvest. Hence in the spring time the farmer is uncertain about the area of forage and grain needed to produce the necessary feed for the livestock. However, some decisions can be postponed until better information is available. Although adjustments can be made at any time, we assume for simplicity that the farmer will do the necessary adjustment only once during the year, in mid September. At that time, the type of crop growing season will be known, the grazing season is completed and the herd's indoor-season starts. The second-stage decisions allow us to model a response to the observed crop yields outcome. One set of second-stage (recourse) variables for each state of crop yields outcome is defined. Depending on earlier decisions and the seasonal condition, feedstuffs can be sold or purchased. Bulls can be sold or retained. The possibility to adjust the farm plan in response to uncertain intermediate outcomes of crop yields creates a case of embedded risk, as illustrated in the lower branch of Fig. 1. Embedded risk is modelled using discrete stochastic programming (Cocks, 1968; Rae, 1971).

In a multi-stage decision problem, the later strategies need to be present in sufficient detail to ensure "correct" first stage decisions. Actual later stage decisions can be resolved by running further more refined models incorporating the outcomes of uncertain events as they unfold (Kaiser and Apland, 1989). With this in mind, it was decided to model forage yield uncertainty with only three outcomes and the same for grain yield uncertainty.

2.1. Farmers' behaviour and risk preferences

We use the expected utility model (which has expected profit maximization as a special case) as a normative model of farmers' behaviour under risk. We assume that farmers are risk-averse (or risk-neutral) and that beliefs and preferences vary between farmers. Many programming approaches for whole-farm system planning under risk aversion are available (Hardaker et al., 2004a: Ch. 9). For our problem we use utility-efficient programming (UEP) (Patten at al., 1988), a method which needs little information about farmers' risk attitudes. Because we assume that farmers are usually risk-averse, we are restricted to using a concave form of the utility function, i.e., $U''(z)<0$, where *z* is net incomes by state. We used the negative exponential function:

$$U = 1 - \exp(-r \times z) \tag{1}$$

where *r* is a non-negative parameter representing the coefficient of absolute risk aversion, $U'(z)>0$, and $U''(z)<0$. This function exhibits constant absolute risk aversion (CARA), which is a reasonable approximation to the real but unknown utility function for wealth for variations in transitory (annual) income (Hardaker et al., 2004b).

2.2. Activities and constraints

The main groups of activities in the model are as follows (first or second stage variables in parentheses):

1. Forage production activities: pasture and cutting areas (stage 1). Grass-clover from cutting areas is conserved as silage for the 255-days indoor season. For both pasture and silage areas four levels of manure application are distinguished (from 0 to 30 tonnes per hectare (t/ha) pasture and from 10 to 40 t/ha silage). Forage yields respond to manure applications, but at a diminishing rate. Protein content is not affected.
2. Grain production activities (stage 1). Barley can be produced at four levels of manure application (from 10 to 40 t/ha). Further, the grass-clover swards are established under-sown in barley, distinguished by the same four levels of manure application. Grain yields respond to manure applications, but at a diminishing rate. Protein content is not affected.
3. Land and manure activities (stage 1). Organically managed land can be rented at a fixed price (NOK (Norwegian kroner) 1500 per ha, €1≈NOK 8.00). Conventionally produced cattle manure can be purchased (NOK 50 per tonne).
4. Forage trade and transfer activities (stage 1 and 2). Surplus grass from grazing fields can be conserved as silage to be used in winter-feeding. One activity for selling and one for purchasing organic silage are available in stage 2. The output of silage to provide the herd with enough forage during the winter period is maintained through three transfer activities, one for each of the livestock categories (dairy cows, heifers, bulls).
5. Concentrates and grain trading activities (stage 1 and 2). Two mixtures of organic concentrate supplements, with different protein contents, can be purchased. In addition, one mixture of conventional origin was allowed (until August 2005). The mixtures are available in both stages. In stage 2, organic barley can be sold or purchased. Home-processed barley can be used as concentrate feed in stage 2.
6. Livestock activities: dairy cows, heifer and beef activities (stage 1 and 2). Cows calve in the middle of May. Livestock are given free access to forage, pasture in

stage 1 and silage in stage 2. Five actual milk yield levels are assumed (from 4000 to 7000 kg milk per cow per year). Higher milk yields are achieved through addition of concentrates, which depress forage intake. Some heifer calves are raised on the farm to replace cows, while the rest are sold at a few weeks old. Heifers follow a standard rearing system, calving at two years age. In stage 1, bull calves can either be sold or kept over the grazing season. At stage 2, remaining bull calves can be sold immediately or be fed over the indoor season and sold as yearlings.

7. Labour activities (stage 1 and 2). Activities expressing the farm family's opportunity cost of labour or off-farm work are included. Provision is made to hire additional labour.
8. Public payment schemes (stage 1 and 2). The prevailing payment schemes (2003/2004) in Norway are included. The schemes are paid per livestock head or per hectare, with rates varying according to crops and type of livestock. Rates are highest for the first hectares and heads. Specific livestock and area payments offered for organic farming are included.

Generally, the technical responses and relationships were built on a large number of sources. Input prices and rates in the payments schemes were taken from NILF (2003).

The main groups of constraints are as follows:

1. Land constraints (stage 1). Own farmland resources are restricted. A limit is included on the amount of land that can be rented.
2. Rotational limits (stage 1). To avoid the build-up of pests and diseases and to have a balance between fertility-building grass-clover leys and exploitative grains, no more than 50% of the area can be cropped for grain. Another constraint ensures that the ley lasts for exactly three years (the sowing year excluded).
3. Milk quota constraint (stage 1). An annual milk quota is included. No possibilities to acquire additional quota are assumed. Production above the quota has no commercial value.
4. Manure allocation and legislation (stage 1). One constraint ensures that manure used in the crops cannot exceed manure produced on the farm and purchased. There are two organic manure legislation constraints (Debio, 2003). The total amount of manure applied on the holding cannot exceed 140 kg of Nitrogen per year/ha of farmland used. Of this manure, up to 80 kg of Nitrogen per year/ha can be conventionally produced.
5. Dairy herd replacement control and birth balances (stage 1). A replacement constraint ensures that the necessary cows will be provided through rearing replacements (30% culling rate). Two birth balance constraints (one per gender) require that the number of calves sold, bulls sold and heifers reared do not exceed the number of calves produced (one per cow per year).
6. Livestock housing requirement (stage 2). Each category of animal requires a minimum surface area for indoor housing (Debio, 2003). The herd's use of surface area cannot exceed the capacity of the free-range livestock shed (230 m^2).

7. Livestock density (stage 2). One constraint ensures that a maximum number of livestock per ha is not exceeded (Debio, 2003).
8. Labour constraints (stage 1 and 2). On dairy farms, labour needs through the year are quite stable. Just one constraint on an annual basis is then adequate to ensure that labour demand does not exceed the supply from family and hired workers. The labour requirements of many jobs are not directly allocable to specific production activities ('overhead' labour). The constraint 'supply of family labour available to production activities' (variable labour, 1500 hours) equals total family labour supply (3500 hours) less overhead labour (2000 hours). The input-output coefficients for variable labour requirements per unit of the activities are assumed to be constant, irrespective of the scale on which the activities are conducted.
9. Public payment constraints linked to payment intervals for hectares or heads in the various support schemes (stage 1 and 2).
10. Fodder production and utilisation (stage 2). Fodder sold and used in livestock production cannot exceed fodder produced (revealed after stage 1) and purchased. There is one constraint for each of pasture, silage and barley.
11. Feeding requirements (stage 1 and 2). Livestock feeding requirements are specified in minimum dry matter requirements of concentrates and pasture in stage 1, and of concentrates and silage in stage 2. Minimum protein requirements are specified for cows in stage 1 and for all types of livestock in stage 2. Sub-matrices for each type of livestock, with a repetition of the feedstuffs in each, are necessary to avoid possibilities for surplus nutrients being passed on from one type of animal to another. One constraint per livestock type ensures that a maximum of 15% of the energy content in the annual feed ration can be of conventional origin (Debio, 2003).

2.3. Specification of stochastic variables

Many of the data requirements for stochastic models are similar to those of deterministic models. However, additional data are needed in stochastic models to represent uncertainty. Outlined here is how we specified the stochastic variables, which were revenue and crop yield variables.

To represent the uncertainty in activity revenues[1], we mainly used the method described in Hardaker et al. (2004a: 80-82). We used historical data from 1993 to 2002 for organic dairy farms in the Norwegian Farm Accountancy Survey to estimate the historical variation in activity revenues per unit within farms between years. The Norwegian Agricultural Economics Research Institute (NILF) collected the data.

In the panel data used, the number of observations for each enterprise varied from 44 to 51 observations. The number of farms was 11. We used the unbalanced panel data to find the parameters that describe the variation in the individual

[1] The dairy activities: Revenues from milk and culled cows minus veterinary, medicine and breeding costs. The calves and bull activities: Revenues from selling livestock minus veterinary and medicine costs.

activity revenues per unit within farms between years. For activity *j* we estimated the following two-way fixed effects model:

$$x_{wT} = \mu + \alpha_w + \beta_T + e_{wT} \qquad (2)$$

where x_{wT} is deflated revenue per unit on farm *w* in year *T* (*T=1,…,10*), μ is general mean, α_w is the effect on revenue due to farm *w*, β_T is the effect on revenue due to year *T*, and the residual e_{wT} is a random variable with mean zero. The estimated individual activity revenue per unit for a representative farm for year *T* is:

$$\hat{x}_{\cdot T} = \hat{\mu} + \hat{\beta}_T \qquad (3)$$

We then removed from the panel data the farm-specific effects caused by different management practices, soil quality etc., $\hat{\alpha}_w$, and unexplained white noise, $\hat{e}_{wT}$. We adjusted for trend by regressing the estimated $\hat{x}_{\cdot T}$ from Eq. (3) against time, *T*, for each activity. We then added the residuals of this regression for each year to our predicted trend value from the regression for the planning year in order to construct de-trended series (row 4 and 5 in Table 1). To reflect the chance that similar conditions to those in each of the data years will prevail in the planning period, we assigned equal probabilities to the historical years or 'states of nature' 1993 to 2002.

Table 1 Distribution of activity revenues in NOK per dairy cow and per calf/bull by state of nature

State	1	2	3	4	5	6	7	8	9	10	Mean	St.dev.
Trend and inflation-corrected historical incomes:												
Probability	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10		
Dairy cow	19,822	16,967	16,540	16,834	16,929	16,975	15,350	16,214	17,818	17,328	17,078	1168
Calf/bull	6838	8364	9387	15,309	9918	11,023	8418	6265	9100	9480	9410	2502
Statistics from elicited subjective triangular distributions:												
Dairy cow											15,483	901
Calf/bull											8503	404
Reconstructed incomes:												
Dairy cow	17,501	15,460	15,542	14,822	15,377	15,463	14,059	14,860	16,062	15,680	15,483	901
Calf/bull	8080	8334	8509	9450	8585	8765	8343	7995	8451	8514	8503	404

Both national and international developments imply that Norwegian agricultural policy will change in the future. In that case, historical data are not relevant in our decision model. We therefore elicited from an expert group of agricultural researchers the subjective marginal distributions of the individual activity revenues. From these experts we received judgements of the lowest, highest and most likely values of individual revenue for the next 2-3 years. Then, assuming that the individual subjective revenues per unit were approximately triangularly distributed, we calculated means and standard deviations, as shown in row 7 and 8 of Table 1.

Finally, the historical revenue series were reconstructed, using the formula (Hardaker et al., 2004a):

$$x(n)_{ij} = E\left(x(s)_j\right) + \left\{x(h)_{ij} - E\left(x(h)_j\right)\right\}\frac{\sigma(s)_j}{\sigma(h)_j} \qquad (4)$$

where $x(n)_{ij}$ is the synthesised revenue for activity *j* in state *i*, $E\left(x(s)_j\right)$ is the subjective mean of the revenue of activity *j*, $x(h)_{ij}$ is the corrected historical revenue of activity *j* in state *i*, $E\left(x(h)_j\right)$ is the mean revenue from the corrected historical data for activity *j*, $\sigma(s)_j$ is the subjective standard deviation of the revenue for activity *j*, and $\sigma(h)_j$ is the standard deviation of the revenue for activity *j* from the corrected historical data. The reconstructed series (the two last rows in Table 1) have the subjectively elicited means and standard deviations while preserving the correlation and other stochastic dependencies embodied in the historical data. The reconstructed revenues used in the model were adjusted according to milk yields for dairy cows and stage of production for calves and bulls.

There may be a stochastic dependency between forage and grain production. If there is a correlation between forage yield per ha and grain yield per ha, this should be reflected in the joint probabilities. In our de-trended[2] historical panel data of organic farms (from the Norwegian Farm Accountancy Survey for the years 1993-2002) we found a significant within farm correlation between forage yield and grain yield of 0.10, implying a weak positive correlation.

We used the same panel data to derive the within farm joint distributions of forage and grain yield. From the data we found the within farm standard deviation for forage yield to be 616 FUm/ha[3]. For each farm we calculated mean forage yield and added/subtracted this standard deviation times 0. In this way we received two farm-specific limits and three farm-specific forage yields intervals. The same procedure was performed for grain yields, that had a within farm standard deviation of 654 FUm/ha. In the next step we counted the numbers of data points in each of the nine cells in the state of nature matrix, and found the proportion of the data points of each cell to estimate the within farm joint probability distribution between forage and grain yields (Table 2).

---

[2] We adjusted for trend by regressing forage yield against time for the whole sample. Then, the regression residual for each observation was added to the predicted forage yield for the planning year 2003. Grain yield was de-trended in the same way. With this approach we assumed an equal trend for every farm in the sample. An alternative approach is to de-trend individually for each farm.

[3] One FUm (feed unit milk) is defined as 6900 kJ of net energy lactation.

Table 2 Within farm joint probability distribution for yields, and mean yields for each interval (FUm/ha)

	Grain yield				
Forage yield	Low	Normal	High	Total	Mean yield
Low	0.068	0.182	0.045	0.295	3521
Normal	0.114	0.159	0.114	0.386	3662
High	0.068	0.136	0.114	0.318	3860
Total	0.250	0.477	0.273	1.000	
Mean yield	3117	3280	3499		

For observations in the low, normal or high production interval, mean values in each interval (Table 2, last row for grain, and last column for forage) were calculated as overall means plus/minus means of deviations from farm means. With this approach to estimate the joint probabilities we used the information that exists in the panel data and we accounted for the specific empirical distributions. For each type of crop in the model, the relative yield differences between the three states of nature in Table 2 determined yield distributions at the various levels of manure application.

2.4. Matrix structure

The two-stage UEP with recourse for the case farm was formulated as follows:

$$\max E[U] = p_{st} U(z_{2st}, r),\ r \text{ varied,} \tag{5}$$

$$\text{subject to } A_1 x_1 \leq b_1, \tag{6}$$

$$B_s x_1 + A_{2s} x_{2s} \leq b_{2s}, \quad s = 1,2,\ldots,9, \tag{7}$$

$$C_{1st} x_1 + C_{2st} x_{2st} - I_{2st} z_{2st} = f_{st}, \quad s = 1,2,\ldots,9, \quad t = 1,2,\ldots,10, \tag{8}$$

$$x_1 \geq 0, x_{2s} \geq 0, \quad s = 1,2,\ldots,9. \tag{9}$$

where:

$E[U]$ = expected utility;

p_{st} = 1 by $s \times t$ vector of joint probabilities of activity revenue per unit outcomes given that crop yield state of nature, s (cf. Table 2) and season state of nature, t (cf. Table 1) has occurred;

$U(z_{2st}, r)$ = $s \times t$ by 1 vector of utilities of net income z_{2st}, where the utility function is defined for a measure of risk aversion, r that is varied in the range $r_L \leq r \leq r_U$;

z_{2st} = $s \times t$ by 1 vector of net income;

A_1 = m_1 by n_1 matrix of technical coefficients in stage 1;

A_{2s} = m_{2s} by n_{2s} matrix of technical coefficients in stage 2 and state s;

x_1 = n_1 by 1 vector of activity levels of first-stage decision variables, representing decisions that must be made before the values of uncertain parameters are observed;

x_{2s} = n_{2s} by 1 vector of activity levels of second-stage decision variables given state s, representing recourse actions that can be taken after a specific realization of the embedded risk parameters is observed;

b_1 = m_1 by 1 vector of resource stocks in stage 1;

b_{2s} = m_{2s} by 1 vector of resource stocks in stage 2 and state s;

B_s = set of s matrices linking first and second stage activities;

C_{1st} = $s \times t$ by n_1 matrix of activity revenues per unit level in stage 1;

C_{2st} = $s \times t$ by n_{2s} matrix of activity revenues per unit level in stage 2;

f_{st} = $s \times t$ by 1 vector of fixed costs;

I_{2st} = set of $s \times t$ by $s \times t$ identity matrices in stage 2.

Eq. (6) represents the immediate first-stage constraints, those that involve only the variables that cannot be delayed. Eq. (7) denotes the second-stage constraints for each state of crop yields. In Eq. (8) activity revenues of first- and second-stage decision variables are linked to the accounting of the final net incomes for each state of crop yields s and season t. The net incomes are transferred into expected utility in the non-linear objective function (Eq. 5).

The matrix developed comprised about 380 activities and 350 constraints. It was solved using GAMS/CONOPT3. Because this software does not include a parametric programming option, solutions were obtained for stepwise variation in r (cf. Eq. 1).

2.5. Stochastic efficiency analysis

Hardaker et al. (1991) proposed that the efficient solution within the range $r_L \le r \le r_U$ of the UEP is identical with the concept of stochastic dominance with respect to a function (Meyer, 1977), or the alternative concept stochastic efficiency with respect to a function (SERF) (Hardaker et al., 2004b). The general rule for SERF analysis is that the efficient set contains only those alternatives that have the highest expected utility (measured as certainty equivalents[4]) for some value of r in the relevant range between r_L and r_U. In a utility-efficient stochastic programming model the efficient frontier is directly obtained.. The SERF procedure can, *inter alia*, be used to rank various policy alternatives and farm strategies.

Anderson and Dillon (1992) proposed a classification of degrees of risk aversion, based on the relative risk aversion with respect to wealth $r_r(w)$ in the range 0.5 (hardly risk-averse at all) to about 4 (very risk-averse). If the coefficient of absolute risk aversion with respect to wealth $r_a(w)$ is needed, we can use $r_a(w) = r_r(w)/w$ (Arrow, 1965). In this paper, we do not consider utility and risk aversion in terms of wealth, but in terms of transitory income (i.e., a bad or good result in one year

[4] Certainty equivalent (CE) is defined as the sure sum with the same utility as the expected utility of a risky alternative (Hardaker et al., 2004a).

has little or no effect on the probability distribution of income in subsequent years, cf. Friedman (1957)). Since we use a negative exponential utility function in terms of transitory income, z, we need a relationship between $r_r(w)$ and $r_a(z)$. Assuming asset integration, Hardaker et al. (2004a) show that:

$$r_a(z) = r_r(w)/w \tag{10}$$

In other words, we need to divide $r_r(w)$ by *w* to obtain the corresponding value expressed as $r_a(z)$. The typical level of a farmer's wealth, *w*, is assumed to be NOK 1,350,000. Then, a value of $r_a(z)$ in the range 0 (risk-neutral) to 0.000003 (highly risk-averse) corresponds to a $r_r(w)$ in the range 0 to 4. This range was used as the risk aversion bounds in this analysis.

3. Application

3.1. Results under prevailing economic conditions

The model was applied for a case farm that reflects the conditions for a typical organic dairy farm in the lowlands of Southern Norway. The farmer owned 25 ha of land, and an additional 15 ha of land could be rented. The annual milk quota was 100,000 litres.

The main results under prevailing economic conditions are first presented. Table 3 summarizes the main activities in stage 1 for the model at different degrees of risk aversion. One important observation is that degree of risk aversion did not influence the optimal activity choice. The very risk-averse farmer ($r_r(w) \approx 4$) (as well as less risk-averse farmers, not shown in Table 3) chose the same farm plan as a risk-neutral farmer ($r_r(w) = 0$). Another striking aspect was the rather small fall of the CE with increasing risk aversion, which may reflect the small variability of prices and production between good and bad years.

Table 3 Summary of optimal farm management activities in stage one

	Coefficient of risk aversion	
$r_a(z)$	0	0.000003
$r_r(w)$	0	≈ 4
Economic results (1000 NOK)		
Expected net income/certainty equivalent (CE)	252.8	252.2
Area payments	168.4	168.4
Land use (ha)		
Own land	25	25
Rented land	15	15
Land for grazing, 10 tonne of manure/ha	9.1	9.1
Land for silage, 20 tonne of manure/ha	16.7	16.7
Land for grain, 30 tonne of manure/ha[1)]	14.2	14.2
Purchase of manure (tonne)	485	485
Livestock management		
Dairy cows, 5985 kg milk/cow	19.2	19.2
Heifers	5.8	5.8
Sold female calves	3.8	3.8
Keep male calves	9.6	9.6
Milk supply (1000 litres)	100	100
Concentrates, purchased (tonne feed)	12.2	12.2

1) Sward establishment under-sown in barley is included (8.6 ha)

Available own and rented land was fully used. More than 25 ha were allocated to forage crops, the rest to grain (included sward establishment under-sown in barley). Manure applications per hectare were highest in grain and lowest in pastures. The model chose to purchase 485 tonnes of conventional manure, applied in addition to manure from the owned herd.

The milk quota was produced with 19.2 moderate yielding cows. The numbers of young stock were determined by the fixed replacement rate. All male calves were kept over the grazing season.

In stage 2, the optimal plans for risk-averse farmers were identical with those identified for risk-neutral farmers. Table 4 illustrates main features of the tactical decisions at stage 2 for the risk-neutral farmer. Many of the tactical decisions were identical in all of the possible states, the numbers of livestock included. The main adjustment to the various crop yield states in stage 2 was to buy and sell grain and silage, depending on the crop yield outcomes. Available family labour not used in the farm business, was used off-farm. This implies that the modelled marginal value of farm labour at least equals the wage rate off-farm (NOK 100 per hour in the calculations).

Table 4 Summary of optimal farm management activities in stage two for a risk-neutral decision maker

	LL[1)]	LN	LH	NL	NN	NH	HL	HN	HH
Grain trade (tonne)[2)]	−22.8	−24.0	−27.0	−21.7	−24.0	−27.0	−21.7	−24.0	−27.0
Silage trade (tonne DM)[2,3)]	2.2	2.2	2.2	0.0	0.0	0.0	−3.1	−3.1	−3.1
Concentrates (tonne feed)	5.3	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Keep bulls	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Livestock paym. (1000 NOK)	152	152	152	152	152	152	152	152	152
Use of livestock shed (m^2)	197	197	197	197	197	197	197	197	197
Off-farm work (hours)	72	72	72	72	72	72	72	72	72

1) LL, low forage yield and low grain yield: LN, low forage yield and normal grain yield: LH, low forage yield and high grain yield: ... : HH, high forage yield and high grain yield.
2) A positive sign indicates purchase of fodder, a negative sign sale of fodder.
3) DM = dry matter.

Under the prevailing economic conditions, the main solution determinant was not the farmer's risk aversion, but other factors and constraints in the organic dairy system. These results support some previous studies that show the cost of ignoring risk aversion may be small in short-run decision problems in farming (e.g., Pannell et al., 2000; Lien and Hardaker, 2001).

3.2. Effects of greater farm income variability

Norwegian dairy farmers' incomes have been stable over recent decades, as the numbers in Table 1 illustrate. Agricultural policies are being increasingly deregulated and liberalised. One of several effects may be higher instability of farm-level prices and income. To illustrate farm-level effects of a very high price and income variability, we increased, compared to the present situation, the dairy revenue variability from CV 0.06 to 0.31, and the calf/beef revenue variability from CV 0.05 to 0.31 (cf. Table 1). Farmers' economic consequence of this constructed income instability scenario, compared to the prevailing conditions, is illustrated in Fig. 2 with a CE-graph using SERF-analysis.

The CE-graph shows the expected net income (when coefficient of risk aversion is zero) and CE of net income at different degrees of risk aversion. As expected, since we only changed the variability of activity revenues (and not the expected revenues), compared to the prevailing system, a risk-neutral farmer $(r_r(w)=0)$ perceived the same utility of net income under the two scenarios. However, at greater farm income variability a very risk-averse farmer ($r_r(w)\approx 4$) perceived the CE of net income considerably lower (NOK 238,000) than the risk-neutral one (NOK 252,800). The farmer's degree of risk aversion in the instability scenario also had effects on the optimal farm plan. Land in grain increased from 14.2 to 18.5 ha (partly because grain is relatively less risky than dairy and beef in this scenario), the number of dairy cows were reduced from 19.2 to 16, only 83% of the milk quota was produced, more time was allocated to the risk-free off-farm alternative, and several tactical decisions in stage 2 varied significantly between states.

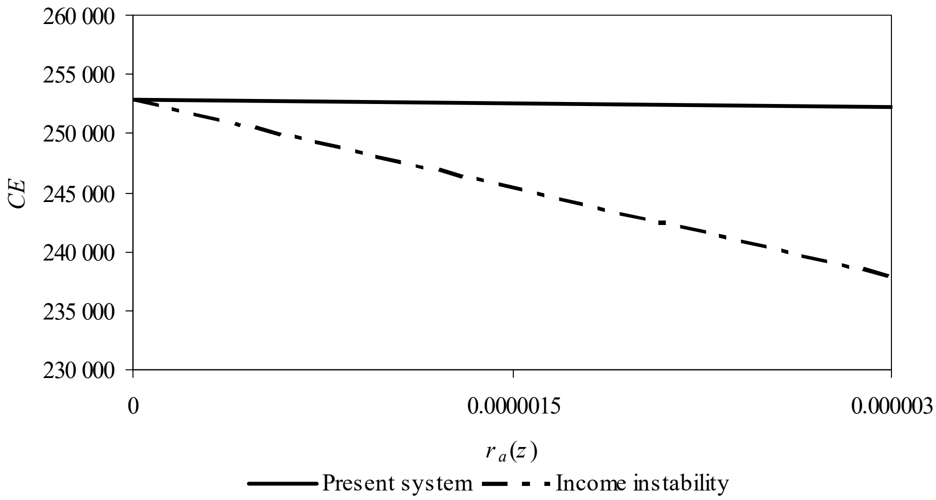

Fig. 2 Certainty equivalents (CEs) under present economic conditions and a constructed income instability scenario. $r_a(z)$ in the range 0 to 0.000003 corresponds approximately to in the range 0 to 4.

4. Concluding remarks

The objective of this paper was to present a two-stage stochastic utility efficient programming model with recourse applied to an organic dairy farm, and to illustrate how this model can be used in a stochastic dominance framework to examine farm strategies and policies under various scenarios. The model includes risk aversion in the decision maker's objective function as well as both embedded and non-embedded risk. We assumed a one-year farm plan starting in the springtime. The second-stage decisions allowed us to model a response to the observed crop yields outcome after harvesting in the autumn. One set of second-stage (recourse) variables for each of the nine states of crop yields outcome was defined, involving for example feed purchase decisions for the indoor season.

As an illustration of its many potential applications, the proposed model was used to analyse optimal farm plans for an organic dairy system in Norway. Under prevailing economic conditions we did not find any shifts in resource use with increased risk aversion, and the risk-averse farmer was only marginally worse off (measured in certainty equivalents) than the risk-neutral farmer. Other factors, such as production constraints and institutional constraints in (organic) farming appeared more important for the farm plan than the degree of risk aversion, and with a more detailed representation of the production system more sensitivity in the results could have been disclosed. However, in a situation with greater farm income variability, risk aversion may be of higher importance for the optimal plan as well as for how the farmer perceives the utility of income.

Future work will include more applications. For example, the EU regulation governing organic production required 100% organic feed in organic dairy systems from August 2005 compared with 85% earlier in Norway. The model developed can be used to assess adjustments in resource use and financial impacts on organic dairy herds, enabling farmers to make better-informed decisions under the new regulation.

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Vedlegg 11

Organic dairy farming in Norway under the 100% organically produced feed requirement*

Ola Flaten and Gudbrand Lien
Norwegian Agricultural Economics Research Institute
Corresponding author: ola.flaten@nilf.no

Abstract

The EU regulation governing organic production will require 100% organic feed in organic dairy systems from August 2005 compared with 85% currently in Norway. This study aimed to assess adjustments in resource use and financial impacts on organic dairy herds using a discrete stochastic programming model. Farm management effects of the regulatory change varied between farm types. For the two organic dairy systems examined, both having a milk quota of 100 000 litres but with varying farmland availability, the introduction of the 100% organic feed regulation resulted in an economic loss of approximately 6-8% of the net income compared to the current regime. The economic loss was mainly due to the considerable higher price of organic compared to conventional concentrates.

Key words: feed regulation, organic farming, milk production, stochastic programming

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Introduction

The EU regulation governing organic production required 100% organic feed in organic livestock systems from 25 August 2005 (CEC, 1999). Earlier, the maximum percentage of conventional feedstuffs authorized per year was 10% in the case of herbivores (15% in Norway) and 20% for other species. The requirement for 100% organic feed will potentially have the greatest impact on organic dairy systems (Nicholas et al., 2004).

The new regulation will directly impact on the price of purchased concentrates since organic concentrates are more expensive than conventional ones. This may subsequently influence many aspects of the farming system and its financial performance. Dairy farmers are faced with a large number of options or combinations of options, including direct substitution of purchased conventional concentrates with purchased organic concentrates, growing more concentrate feeds on the farm, reducing the use of concentrates and increasing the use of forage, purchasing of livestock manure, and reducing the beef enterprise activity or the milk production. The profitability of the options may vary according to the farm conditions (e.g., farm resources, climate, and managerial ability), the market situation for feeds, milk and meat and the public payment system. How the new regulation will affect organic dairy systems is however to a great extent unknown, and research needs to be undertaken to assess the various options under a variety of conditions (Nicholas et al., 2004).

Mathematical programming techniques have been applied frequently in farm-level studies to establish optimal farming systems. These techniques can be used to examine how the new EU regulation will affect organic dairy systems. The programming approach has power and flexibility for whole-farm studies involving joint emphasis on biology and economics and where the research models must be able to simulate farmers' behavior outside historical observations (Pannell, 1996). Deterministic linear programs have often been applied in studies of dairy farming systems; conventional (e.g., Ramsden et al. 1999; Berentsen, 2003) as well as organic (e.g., Berentsen et al., 1998; Pacini et al., 2004). A few dairy models have also accounted for uncertainty (that is, one or more of the coefficients in the models are not fully known at the time of decision making) and how to adjust, as part of the risk is resolved as time goes on and adaptive, sequential decisions can be made (e.g., Lien and Hardaker, 2001).

The aim of this study is to assess adjustments in resource use and financial impacts due to the 100% feed regulation on organic dairy herds under lowland conditions in Norway. Farm practice and financial performance before and after the introduction of the 100% feed regulation in two farming systems that differ in farmland availability will be examined by use of an optimizing farm-level programming model that accounts for both embedded and non-embedded risk. A situation where purchase of organic silage is possible will be analyzed.

Materials and methods

A two-stage discrete stochastic programming model of organic dairy farms was used to examine farm-level effects of the 100% feed regulation. Two types of model farms reflecting conditions for typical organic dairy farms in the lowlands of Southern Norway were analyzed. The annual milk quota on both farms was 100 000 liters. The first farm (the 40 ha farm) owned 25 ha of farmland; an additional 15 ha of land could be rented. The second farm only owned 22 ha of land with no land rent possibilities.

In the model a risk-neutral farmer maximize expected net income (i.e., the family's return to farm as well as off-farm labor and management). Fixed costs are deducted from the income measure. The fixed costs are NOK 300 000 for the 40 ha farm and NOK 260 000 for the 22 ha farm (€ 1 = NOK 8.15, NOK is Norwegian kroner).

The model assumes a one-year plan starting in spring. First-stage decisions are, e.g., how many cows and heifers to keep, allocation of land to various crops, and the use of manure. Once the numbers of cows and heifers are decided, the dairy herd size is fixed. The risk associated with the dairy herd is thus non-embedded risk, as indicated by the upper branch of Figure 1.

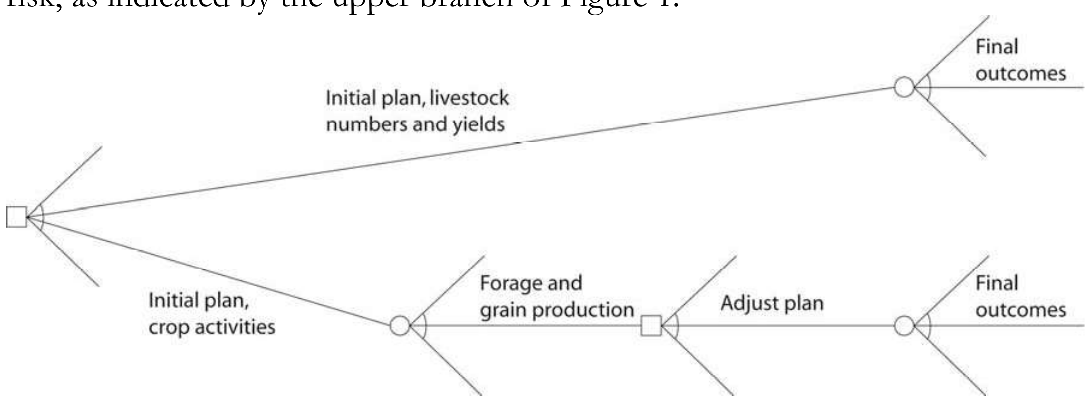

Figure 1. Outline decision tree for our problem

The actual yields are being known only after harvest. In the spring time the farmer is uncertain about the area of forage and grain needed to produce the necessary feed for the livestock. However, some decisions can be postponed until better information is available. We assume for simplicity that the farmer will do the necessary adjustment only once during the year, in mid September. At that time, the type of crop growing season will be known, the grazing season is completed and the herd's indoor-season starts. The second-stage decisions allow us to model a response to the observed crop yields outcome. One set of second-stage variables for each state of crop yields outcome is defined. Feedstuffs can be sold or purchased. Bulls can be sold or retained. The possibility to adjust the farm plan in response to uncertain intermediate outcomes of crop yields creates a case of embedded risk, as illustrated in the lower branch of Figure 1.

Land can be used for growing clover grass and barley. Clover grass can be used for grazing or for silage making to be used in the indoor season. Silage can be traded. The grass-clover swards are established under-sown in spring barley and last for three years (the sowing year excluded). Barley can also be sown as the only crop. To avoid the build-up of pests and diseases and to have a balance between fertility-building grass-clover leys and exploitative grains, no more than 50% of the area can be cropped for grain. The barley crop can be sold or used as home-processed concentrate in stage 2. All crop yields respond to manure applications, but at a diminishing rate. For all crops four levels of manure applications are distinguished; from 0 to 30 tonnes (t) per ha for pasture and from 10 to 40 t/ha for silage and barley. Conventional produced cattle manure can be purchased.

Generally, the technical responses and relationships in the model were built on a large number of sources. Deterministic input prices were taken from NILF (2003).

Two mixtures of organic concentrate supplements as well as one of conventional origin could earlier be purchased. Table 1 shows their prices and protein contents.

Table 1 Prices and protein contents of purchased concentrate mixtures

	Prices 2004, NOK[1]/kg feed	Protein contents	
		AAT[2], g/kg feed	PBV[2], g/kg feed
Conventional concentrate	2.65	95	19
Organic standard concentrate	3.80	87	-10
Organic protein concentrate	5.00	156	88

1) € 1 = NOK 8.15

2) AAT = amino acids absorbed in the small intestine, PBV = protein balance in rumen

Farm livestock includes dairy cows, followers and beef bulls. Cows calve in the middle of May. Livestock are given free access to forage, pasture in stage 1 and silage in stage 2. Higher milk yields are achieved through addition of concentrates, which depress forage intake. Five actual milk yield levels are assumed (from 4000 to 7000 kg milk per cow per year). Heifers raised on the farm replace cows (30% culling rate), the rest of the female calves are sold at a few weeks old. Heifers are calving at two years age. In stage 1, bull calves can either be sold or kept over the grazing season. At stage 2, remaining bull calves can be sold immediately or be fed over the indoor season and sold as yearlings. Livestock feeding requirements are specified in minimum dry matter requirements of concentrates and forages and minimum protein requirements, specified for all stages and types of livestock.

The farm family has the opportunity to work off-farm. Provision is also made to hire labor. One constraint on an annual basis ensures that labor demand does not exceed the supply from family and hired workers. Total family labor supply is 3500 hours.

The prevailing payment schemes (2003/2004) in Norway are included. The schemes are paid per livestock head or per hectare, with rates varying according to crops and type of livestock. Rates are highest for the first hectares and heads. Specific livestock and area payments offered for organic farming are included.

Panel data from 1993 to 2002 for organic dairy farms in the Norwegian Farm Accountancy Survey were used to estimate the historical variation in enterprise income and crop yield variables within farms between years. These historical variations and combined with subjective judgments of the lowest, highest and most likely values of individual incomes in the next year for the income variables represent the uncertainty in the stochastic variables. Forage yield uncertainty is modeled with three outcomes and the same for grain yield uncertainty, in total nine states of nature for yield combinations. For the final financial outcomes (of the stochastic enterprises dairy and beef/calf), ten states of nature are modeled. The mean of the stochastic enterprise incomes are set equal to the 2004 price level.

Organic legislation regarding use of manure, livestock housing requirements, livestock density and feeding requirements (Debio, 2003) are handled through a number of constraints. The herd's use of surface area cannot exceed the capacity of the free-range livestock shed (230 m^2).

One constraint per livestock type ensures that a maximum of 15% of the energy content in the annual feed ration are of conventional origin (Debio, 2003). With the new 100% organic feed regulation this option was removed. All types of livestock are fed a diet consisting of at least 60% forage, on a dry matter basis.

Results

Table 2 summarizes the main activities in stage 1 under the 85% as well as the 100% feed regulation for both of the farm types. Table 3 illustrates the main features of the tactical decisions at stage 2. The model results in Tables 2 and 3 include the possibility of buying indefinite quantities of silage.

Table 2 Model solutions in stage 1 for two different farmland sizes before and after the 100% organic feed regulation

Activities	**Land 40 ha 85% org.**	**Land 40 ha 100% org.**	**Land 22 ha 85% org.**	**Land 22 ha 100% org.**
Economic results (1000 NOK)				
Expected net income	345.3	325.5	221.9	203.2
Area payments	159.7	159.7	91.5	91.5
Land use (ha)				
Own land	25.0	25.0	22.0	22.0
Rented land	15.0	15.0	0.0	0.0
Land for grazing, 10 m^3 manure/ha	10.0	10.0	6.5	6.8
Land for silage, 20 m^3 manure/ha	18.6	18.6	10.0	9.7
Land for grain, 30 m^3 manure/ha[1)]	11.4	11.4	5.5	5.5
Purchase of manure, m^3	413	413	120	122
Livestock management				
Dairy cows	21.1	21.1	16.2	16.0
Kg milk/cow	5500	5500	7000	6603
Concentrates, kg DM per cow	808	808	2379	1920
Heifers	6.3	6.3	4.9	4.8
Sold calves	4.2	4.2	3.3	3.2
Keep male calves	10.5	10.5	8.1	8.0
Milk supply, 1000 liters	100.0	100.0	100.0	92.6

1) Sward establishment under-sown in barley is included

The 40 ha farmer under the 85% organic feed regime used all of the available own and rented land (Table 2). More than 28 ha were allocated to forage crops, the rest to grain. Manure applications per ha were highest in grain and lowest in pastures. The model chose to purchase 413 t of conventional manure, applied in addition to manure from the own herd. The milk quota was produced with 21 cows each yielding 5500 kg milk annually. Male calves were kept over the grazing season. The main adjustments in stage 2 were to sell silage in the best forage years and to sell some bulls at the start of the indoor season in the weak forage years (Table 3). All farm-produced grain was sold off-farm. More than 23 t of concentrates were purchased, 17 t of it of conventional origin. Available family labor (3500 hours) not used in the farm business, was used off-farm (at a wage rate of NOK 80 per hour).

Table 3 Model solutions in stage 2 for two different farmland sizes before and after the 100% organic feed regulation

	LL[1)]	LN	LH	NL	NN	NH	HL	HN	HH
Land 40 ha, 85% organic / 100% organic									
Grain trade, t[2)]	-33.3	-35.1	-37.4	-33.3	-35.1	-37.4	-33.3	-35.1	-37.4
Silage trade, t[2)]	0.0	0.0	0.0	0.0	0.0	0.0	-4.4	-4.4	-4.4
Concentrates, t[3)]	23.2	23.2	23.2	23.9	23.9	23.9	23.9	23.9	23.9
– conv. conc., t feed[3,4)]	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Keep bulls	6.6	6.6	6.6	10.5	10.5	10.5	10.5	10.5	10.5
Use of livestock shed, m^2	200	200	200	216	216	216	216	216	216
Livestock paym., 1000 NOK	157	157	157	159	159	159	159	159	159
Off-farm work, hours	23	23	23	7	7	7	7	7	7
Land 22 ha, 85% organic									
Grain trade, t[2)]	-15.7	-16.5	-17.6	-15.7	-16.5	-17.6	-15.7	-16.5	-17.6
Silage trade, t[2)]	8.5	8.5	8.5	6.8	6.8	6.8	4.5	4.5	4.5
Concentrates, t[3)]	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2
– conv. conc., t feed[3,4)]	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1
Keep bulls	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use of livestock shed, m^2	134	134	134	134	134	134	134	134	134
Livestock paym., 1000 NOK	138	138	138	138	138	138	138	138	138
Off-farm work, hours	365	365	365	365	365	365	365	365	365
Land 22 ha, 100% organic									
Grain trade, t[2)]	-15.7	-16.5	-17.6	-15.7	-16.5	-17.6	-15.7	-16.5	-17.6
Silage trade, t[2)]	10.5	10.5	10.5	8.9	8.9	8.9	6.6	6.6	6.6
Concentrates, t[3)]	37.1	37.1	37.1	37.1	37.1	37.1	37.1	37.1	37.1
Keep bulls	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use of livestock shed, m^2	132	132	132	132	132	132	132	132	132
Livestock paym., 1000 NOK	137	137	137	137	137	137	137	137	137
Off-farm work, hours	396	396	396	396	396	396	396	396	396

1) LL, low forage yield and low grain yield: LN, low forage yield and normal grain yield: LH, low forage yield and high grain yield: ... : HH, high forage yield and high grain yield.
2) A positive sign indicates purchase of fodder, a negative sign indicates sale of fodder.
3) Sum of purchased concentrates in stage one as well as stage two.
4) Only under the 85% organic feed regime, i.e., zero for the 100% organic feed regulation.

The optimal farm management activities for the 40 ha farm were similar under the 85% and the 100% organic feed regulation. The only adjustment in the production system was direct substitution of the purchased conventional concentrate mixture with purchased organic concentrate mixtures. The decrease in expected net income was NOK 19 750 (i.e., 6.7% of the original expected net income).

The second farm type had only 22 ha land available. In the 85% organic feed situation, grain was only produced as a cover crop in the sward establishment years. The milk quota was produced with much higher yielding cows (7000 kg milk per cow) than at the 40 ha farm. The cows' intake of forage was then less, as the supply of concentrates was higher. The bull calves were only kept over the grazing season. In all states of nature silage was purchased, and most in the weak forage years. Approximately 46 t of concentrates were purchased, included 16 t of conventional supplements. More family labor was allocated off-farm than on the 40 ha farm.

The 22 ha farmer coped with the change in the EU feed regulation in a number of ways. The lower yielding cows reduced the need of concentrate supplements with around 400 kg per cow. This change was driven by the higher prices of organic concentrate mixtures compared to the conventional price (a price differential of at least NOK 1,15 per kg feed, cf. Table 1). The cows were also slightly fewer, and only 93% of the milk quota was produced. More silage was purchased than under the 85% regulation, while 9 t less of concentrates were purchased. As under the 85% regulation, none of the bull calves were kept over the indoor season. Reduced farm activity compared to the earlier regulation was connected with increased off-farm work. The financial outcome of the 100% organic feed regulation was an expected economic loss of more than NOK 18 750 annually (i.e., 8.4% of the original expected net income).

Discussion

The production of organic milk and meat based entirely on organically produced feed, precludes the use of significantly cheaper conventional concentrates. One adjustment to a situation with more expensive concentrates can be to reduce the input of concentrates per cow (and consequently the milk yield per cow). Then more milk is produced from forage. This effect was found for one of the farm type cases. In the other case, the only adjustment in the production system was direct substitution of conventional purchased concentrates with organic purchased concentrates. This can be the real-world situation. The direct substitution may also be caused by the stability of the linear programs within certain ranges; by increasing the number of activities for the piecewise yield response functions more fine-tuned changes in the farming systems could have been disclosed. In any case, the 100% feed regulation caused economic losses in the magnitude of 6-8% of the expected net income.

Some options to mitigate the new EU regulation and the higher costs of purchased concentrates were not examined in this study. Only one type of a typical silage quality (the first cut approximately one week after heading) was assumed. Feeding of higher-quality forage would reduce the amount of concentrates required to produce a given output of milk. Harvesting at earlier stages would however impact on forage yields, the swards' winter survival and silage production costs. In addition, the silage fermentation does influence the quality of silage. The calving pattern, not handled as a decision variable in the model, is another factor influencing the input of concentrates.

Finally, the model's input and output prices are assumed fixed and exogenous, the price of organic concentrate mixtures and organic silage included. The new EU regulation will however lead to increased demand for organic concentrates. If the supplies of organic feed grains do not keep pace with the increased demand, organic concentrate prices may be pushed even higher. From the organic dairy farmers' point of view, reduced price premiums of organic concentrates would be one way to moderate the negative financial impacts of the 100% organic feed regulation. On the other side, cheaper concentrates would discourage increased use of forages in the dairy herds' diets.

Conclusion

A discrete stochastic programming model was used to examine optimal strategies in organic dairy systems in Norway, enabling farmers to make better-informed decisions under the new EU regulation requiring 100% organically produced feed from 25 August 2005.

Farm management effects of the 100% organic feed regulation varied between the two examined farm types, both with a milk quota of 100 000 liters. With much land available (40 ha), the only adjustment was to substitute conventional purchased concentrates with more expensive organic concentrates. In the situation with less land available (22 ha), lower yielding cows, more purchase of silage and reduced total milk production were the profitable adjustments. In both cases, the organic dairy system faced a substantial economic loss of almost NOK 20 000 (or 6-8% of the expected net income) with the regulatory change compared to the earlier regime. Because of the price premium of organic concentrates, dairy farmers also need to pay attention to forage quality and the calving pattern, in order to control the input of high-priced organic concentrates.

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Vedlegg 12

Comparison of risk in organic, integrated and conventional cropping systems in eastern Norway*

Gudbrand Lien[1,2], Ola Flaten[1], Audun Korsaeth[3], Keith D. Schumann[4], James W. Richardson[4], Ragnar Eltun[3], and J. Brian Hardaker[5]

[1]Norwegian Agricultural Economics Research Institute
[2]Eastern Norway Research Institute
[3]Norwegian Crop Research Institute
[4]Texas A&M University
[5]School of Economics, University of New England, Australia
Corresponding author: gudbrand.lien@nilf.no

Abstract

The aim of this study was to compare risk of organic, integrated and conventional cropping systems. Experimental cropping system data (1991-1999) from eastern Norway were combined with farm budget data. Empirical distributions of net farm income for different cropping systems were estimated with a simulation model. The results show that the organic system had the greatest net farm income variability, but both the existing payment system and organic price premiums make it the most economically viable alternative.

Key words: Risk analysis, crop farming, cropping systems, stochastic simulation, risk aversion, stochastic efficiency with respect to a function

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Introduction

There is general agreement that sustainable agriculture refers to the use of resources to produce food and fibre in such a way that the natural resource base is not damaged, and the basic needs of producers and consumers can be met over a long term. Sustainable agriculture entails ecological, social and economic aspects (Yunlong and Smit, 1994). The choice of cropping system is an important issue as different systems have different environmental, agronomic and economic consequences.

Comparing different cropping systems requires a systems or whole-farm approach (and not partial analysis), because factors interact. A cropping systems project with the aim of allowing comparison of different cropping systems was initiated in 1989 at Apelsvoll Research Centre in eastern Norway. Eltun *et al.* (2002) compared environmental, soil fertility, yield and economic effects between the cropping systems. However, the economic analysis ignored the effects of risk on the selection of cropping systems.

There are reasons to believe that different cropping systems perform differently given the same weather conditions and thus have different impacts on income risk for a farm. For example, restrictions on pesticide and fertiliser use may give rise to different production risk in organic farming than in conventional farming. Additonally, smaller organic markets may mean greater price fluctuations.

These types of risks should be considered when comparing economic viability between cropping systems, because most farmers are risk-averse, and there is a need to account for downside risk (Hardaker *et al.*, 2004a). Yet most economic studies comparing cropping systems look exclusively at expected profitability measured by average net farm income (Roberts & Swinton, 1996). However, expected profitability is an insufficient criterion as it ignores likely differences in the riskiness of net income between cropping systems.

One way to assess and compare profit (in)stability is by using stochastic simulation. Mahoney *et al.* (2004), Smith *et al.* (2004), and Ribera *et al.* (2004) all used stochastic simulation to apply a stochastic dominance framework on experimental data to analyse income risk differences between arable crop systems in the United States, while Langyintuo *et al.* (2005) has done a similar study of rice farming in Ghana.

We expand on the procedure used by Ribera *et al.* (2004). Our goal is to compare the distributions of returns between conventional, integrated and organic cropping systems in eastern Norway, and to quantify the importance of specific organic area payments and price premiums on economic viability. The Apelsvoll experimental cropping data are supplemented with farm budget data.

Materials

It is hard to find relevant and reliable data to compare differences for the distributions of returns between cropping systems. One option is to use non-experimental farm-level panel data, i.e., repeated observations over time on the same farms. There are two main problems with non-experimental farm-level panel data for comparing risk between cropping systems: 1) sufficient data for two or more farming systems on the same farm grown over the same years are very difficult (if not impossible) to find; 2) unless sufficient data from a single farm are available, comparative data from different farms would include noise, such as different climate, soil and growing conditions, disease and weed stress, topology conditions, and farm management practice, that have little to do with differences in risk between the cropping systems.

An alternative to farm-level panel data is to use yield data from verified scientific experiments of cropping system treatments. Then most of the problems mentioned in point 2 above can be avoided. The problems with using experimental data are: 1) usually few observations; 2) that farm practices and results from experimental conditions may differ from what is obtained on real farms; and 3) data often only from one site (usually an experiment station).

This last point reduces the scope to generalise the results. However, some general implications may be drawn from such information, since it is the differences in risky outcomes between cropping systems which are the focus of this study. Moreover, for our study, the experimental practice and yields were quite close to what is typical for crop farms in eastern Norway. Our approach to deal with the problem of sparse data is discussed in the «Method» section.

Stochastic variables

Most of the stochastic yield variables were based on the experimental cropping data from Apelsvoll Research Centre. The field experiment started in 1989 but, because it takes some time to get a system established, the data used in this study are based on the results for 1991-1999. The period 1991-1999 was fairly representative of the normal annual variation in growing conditions at the site.

Three cropping systems are included in our data set: CON – conventional crop production without manure as a fertiliser supplement; INT – integrated crop production without manure; and ORG – organic crop production with manure as a fertiliser. Each cropping system in the experiment was studied on two model farms, each of 0.18 ha. Each model farm had eight rotation plots and an eight-year crop rotation. All of the crops in each rotation were grown each year. For commercial non-organic crop operations in Norway somewhat simpler rotations are more commonly used. Table 1 summarizes the main characteristics of the cropping systems. The experimental design, management of individual cropping systems and soil conditions on the model farms are described in more detail in Eltun *et al.* (2002).

Inspection of the experimental data permitted the combination of some of the crops within a rotation (varieties of the same crops) without significantly reducing the information from the experiment. The consolidation resulted in six crops in the CON and INT systems and seven crops in the ORG system. Table 2 shows the descriptive yield statistics and elicited expert judgements (prepared by a group of crop researchers related to the experiment) about probable minimum and maximum yield levels for the individual crops in the three cropping systems.

Table 1 Characteristics of the cropping systems at Apelsvoll Research Centre, eastern Norway 1991-1999

	Cropping system[1]		
Management	**Conventional (CON)**	**Integrated (INT)**	**Organic (ORG)**
Crop rotation	Barley[2]	Barley[2]	Barley[3]
	Winter wheat[4]	Winter wheat[4]	Annual grass-clover
	Oats	Oats	Spring wheat[5]
	Barley	Barley	Potatoes
	Potatoes	Potatoes	Barley[3]
	Spring wheat	Spring wheat	Annual grass-clover
	Oats	Oats	Winter wheat[4,5]
	Barley	Barley	Oats[5]
Fertiliser	Yes	Yes[6]	No
Slurry	No	No	Yes
Soil tillage	Spring ploughing[7]	Spring harrowing	Spring ploughing
Crop protection	Chemical	Integrated[8]	Mechanical

1) The proportion of cropland is equally devoted to each of the eight crops for each of the three rotation systems.
2) Early potatoes in the period 1991-1994.
3) With undersown crop (timothy, red clover and alsike clover).
4) For CON and INT spring wheat in the period 1998-1999. For ORG spring wheat in 1994-1995 and 1998 1999.
5) With undersown crop (annual ryegrass and white clover).
6) Less use of mineral fertilisers compared to the CON system.
7) Autumn ploughing in the period 1991-1994.
8) Less use of pesticides compared to the CON system, mechanical weed control in potatoes.

Compared to the CON system, the average yields were lower for all individual crops in the INT system, and lowest in the ORG system with 60-65% of the conventional yield. Nitrogen supply is the major factor limiting plant growth in organic cropping systems in Norway (Haraldsen *et al.*, 2000), and thus may be the primary cause for lower yields. In Europe, arable crop yields in organic systems are typically 60-80% of those under conventional management (Stockdale *et al.*, 2001; Mäder *et al.*, 2002), while studies from North America have reported smaller yield reductions for organic relative to conventional systems (Stockdale *et al.*, 2001; Mahoney *et al.*, 2004). In the Rodale experiments in Pennsylvania, crop yields under normal rainfall were similar in the organic and conventional systems, whereas the organic system produced higher corn yields under drought conditions (Pimentel *et al.*, 2005).

The relative variability in yields, expressed by the coefficient of variation (CV), was generally highest for ORG, second highest for INT, and smallest for the CON cropping system. However, for potatoes and spring wheat production, the INT rotation system showed the smallest relative variation, while for winter wheat the ORG system showed the smallest CV.

Table 2 Descriptive yield statistics and subjective judgements (prepared by an expert group of crop researchers) of minimum and maximum yields for the individual crops in the cropping systems, 1991-1999.

Cropping system	Barley I[3] (kg ha^{-1})	Barley II[3] (kg ha^{-1})	Oats[4] (kg ha^{-1})	Potato (kg ha^{-1})	Spring wheat (kg ha^{-1})	Winter wheat (kg ha^{-1})	Grass-clover (DM ha^{-1})
Conventional							
Mean	5018	5665	5394	30 839	5903	5867	
CV[1]	27.8	15.9	16.4	23.3	15.9	26.0	
Minimum,o[2]	2718	4053	3812	19 500	4290	4229	
Maximum, o	6871	7124	6897	42 650	7224	8171	
Minimum, s[2]	1600	1600	1800	15 000	1800	1800	
Maximum, s	8700	8700	8600	49 000	8600	9000	
Integrated							
Mean	4496	4908	4816	27 749	4943	5299	
CV	30.1	19.1	21.9	21.4	10.9	25.5	
Minimum, o	2800	3915	2718	22 310	4150	4053	
Maximum, o	6212	6506	6159	40 910	5982	7565	
Minimum, s	1600	1600	1800	15 000	1800	1800	
Maximum, s	7100	7100	7000	47 000	6800	8300	
Organic[5]							
Mean	3165	3823	3415	21 103	3422	3734	8939
CV	43.3	35.3	44.1	43.6	18.0	16.1	22.7
Minimum, o	1320	1320	0	7100	2120	3012	6309
Maximum, o	5329	6306	4900	36 670	4194	4471	11 774
Minimum, s	0	0	0	0	0	0	3000
Maximum, s	6900	6900	5400	42 500	4600	4900	13 000

1) CV = coefficient of variation, defined as standard deviation divided on mean yield.
2) o = observed value from the experiment, s = subjective extreme values given by an expert group.
3) Barley I and Barley II represent two different varieties of barley.
4) For CON and INT the two oats experiment (cf. Table 1) results (same varieties) were combined in one variable.
5) In the ORG system barley and oats are undersown (cf. Table 1). This will be associated with some yield penalty compared with growing them as single crops, and may cause more yield variation compared to the CON and INT systems.

The agricultural policy in Norway is implemented in annual state budgets and in annual negotiations between the two farmers' unions and the government on financial support to agriculture. Financial support is provided through import tariffs and via a set of budgetary payments (area payments in crop farming). In the agricultural agreement target prices (maximum average prices) are set for most commodities (NILF, 2003: 5-30). The potato price has been quite unpredictable, and was stochastically modelled[1]. Deflated (to 2004-money value) historical potato prices in NOK (Norwegian kroner) per kg for 1991-1999 from the Agricultural Price Reporting Office (LP, 2000) were used to specify the empirical potato price distribution. Based on organic potato price premiums in Norway 2003/2004 and price premiums for organic potatoes in other European countries (Offermann & Nieberg, 2000), organic potatoes were assumed to be sold at prices 50% above conventional prices, and with the same relative variability (hence higher absolute variability).

The general level of grain prices has been set annually and can be regarded as non-stochastic in Norway. However, variability in quality parameters such as Hagberg falling number (a measure of starch quality determining whether the grain achieves bread-making quality) and protein content cause some unpredictability in the wheat farm-gate price. These quality parameters were recorded in the experiment and this information was used to model stochastic wheat prices. Table 3 shows the descriptive product price statistics for wheat and potatoes. For all crop products, prices at harvesting were used to account for the value of production and thus to calculate net returns of the particular cropping system. Given the purpose of this study, the whole-farm analysis was not extended to analyse alternative storage and marketing strategies.

Table 3 **Descriptive product price statistics (for CON and INT systems) and product price estimates (for ORG system) in NOK (£1 ≈ NOK 11.8[1] kg for spring wheat, winter wheat and potato. Year 2004 price level.**

Cropping system	Potato	Spring wheat	Winter wheat
Conventional			
Mean	1.66	2.04	1.97
CV[1)]	21.10	8.82	9.25
Minimum	1.18	1.56	1.56
Maximum	2.19	2.10	2.05
Integrated			
Mean	1.66	1.97	1.97
CV[1)]	21.10	11.94	9.25
Minimum	1.18	1.56	1.56
Maximum	2.19	2.10	2.05
Organic			
Mean	2.49	3.18	2.92
CV[1)]	21.10	5.15	7.47
Minimum	1.77	2.76	2.76
Maximum	3.29	3.30	3.17

1) CV = coefficient of variation, defined as standard deviation divided on mean yield.

Deterministic variables

The farm in this study was constructed to have 40 ha of arable land, a typical crop farm size in the region. The farms with CON and INT cropping systems were assumed to grow 15 ha barley, 10 ha oats, 5 ha spring wheat, 5 ha winter wheat, and 5 ha potatoes. The ORG crop systems consisted of 10 ha barley, 5 ha oats, 5 ha spring wheat, 5 ha winter wheat, 5 ha potatoes, and 10 ha annual grass-clover (for silage). These crops mix proportions are the same as were used in the experiment (Table 1).

The price of silage made from grass-clover was treated as deterministic, as were input prices and prevailing area payment schemes (2004/2005). These deterministic data, which were taken from NILF (2004a), are shown in Table 4.

Table 4 **Deterministic product prices in NOK kg^{-1}, area payments and variable costs (VC) in NOK ha^{-1} for individual crops and cropping systems. Year 2004 price level.**

Cropping system	Barley I	Barley II	Oats	Potato	Spring wheat	Winter wheat	Grass-clover
Conventional							
Product price[1)]	1.64	1.64	1.41	1.66b	2.04[2)]	1.97[2)]	
Area payment	3300	3300	3300	2500	3300	3300	
Seeds	782	871	752	4850	1083	950	
Fertilisers	1023	1023	986	2470	1509	1602	
Pesticides	819	729	509	1819	1168	1235	
Machinery[3)]	3142	3142	3142	14 071	3247	3247	
Others[4)]	295	295	295	3295	295	295	
Sum VC	6061	6061	5684	26 505	7302	7329	
Integrated							
Product price[1)]	1.64	1.64	1.41	1.66[2)]	1.97[2)]	1.97[2)]	
Area payment	3300	3300	3300	2500	3300	3300	
Seeds	782	871	752	4850	1083	950	
Fertilisers	744	744	744	1581	905	1046	
Pesticides	379	69	69	632	619	619	
Machinery[3)]	2249	2249	2249	15 202	2606	2606	
Others[4)]	295	295	295	3295	295	295	
Sum VC	4449	4229	4109	25 560	5508	5516	
Organic							
Product price[1)]	2.79	2.79	2.36	2.49[2)]	3.18[2)]	2.92[2)]	1.43[6)]
Area payment[5)]	5800	5800	5800	5000	5800	5800	3540
Seeds	2399	2399	2052	5850	2624	2420	1335
Fertilisers	500	500	500	1000	500	500	
Machinery[3)]	3128	3128	3296	16 365	3296	3128	2296
Others[4)]	295	295	295	3295	295	295	295
Sum VC	6322	6322	6143	26 510	6715	6343	3926

1) Product prices net of yield dependent haulage cost for grain and potatoes and silage making costs for annual grass-clover.
2) Stochastic variables are specified in Table 3.
3) Cost of all machinery operations.
4) The expected value of the stochastic specified irrigation cost is included here, in addition to miscellaneous cost in potato production.
5) Included the specific organic area payments of NOK 2500 ha^{-1} for grains and potatoes and NOK 550 ha^{-1} for grasslands.
6) Product price for annual grass-clover is in NOK $(kg\ DM)^{-1}$

Inputs per hectare of seed, fertiliser/manure, pesticides, and machinery operations were assumed to be identical to those used in the experiment. The costs of machinery operations, reflecting prevailing rental costs in the market, exclusive of operator labour, were based on typical mechanization for 40 ha farms. European studies show labour use in organic crop farming to be 10-20% higher than comparable conventional systems (Offermann & Nieberg, 2000). The labour use does vary from farm to farm depending on the degree of mechanisation, marketing strategies, the enterprise portfolio, etc. The additional labour requirement in ORG was assumed to be 15% more than the 2000 hours of labour for CON. The INT system was assumed to use 20 hours less labour per year than CON because of the less labour intensive tillage system. The farm's total fixed costs for the INT system was estimated at NOK 160 000, based on the Norwegian farm accounting survey (NILF, 2004b). The extra labour cost for CON resulted in fixed costs of NOK 162 684, and for the ORG system the total was NOK 205 284.

Scenarios analyses

The model was used to analyse three scenarios. First, given the prevailing payment system and organic price premiums, the three cropping systems CON, INT, and ORG were compared.

To encourage crop farmers to convert to and continue organic farming practices, the Norwegian government introduced area payments for producing organic field crops in the mid 1990s. It has been demonstrated that some farmers consider the organic area payment as risky and they fear this payment will decrease (Koesling *et al.*, 2004). In scenario two, therefore, the area payment for organic farming is removed. The ORG producers are assumed to receive the same area payments as CON and INT producers.

The price premium may decrease with increased supply of organic product as more farmers convert to organic production. Hence, in scenario three, both the organic payments and the organic price premiums are removed. Scenario three illustrates the economic viability of the ORG system without any price premiums or organic support payments. For this last scenario, input prices for organic seeds are reduced almost to the prices of conventional seeds.

Method

A stochastic simulation model for the hypothetical farm is used to estimate an empirical probability distribution for annual net farm income $(\tilde{I})$. The annual net farm income is a function of area, yield, prices, area payments and costs. More formally, the model used to simulate the three alternative cropping systems can be described as:

$$\tilde{I} = \sum_{j=1}^{k} \left[A_j \left(\tilde{Y}_j \times \tilde{P}_j + AP_j - C_j \right) \right] - FC$$

where

A_j is the area in hectares of crop *j* in the cropping system,

$\sum_{j=1}^{k} A_j$ is then total farm land area,

$\tilde{Y}_j$ is the per-hectare stochastic yield of crop *j*,

$\tilde{P}_j$ is the per-kg stochastic or deterministic price for crop *j*,

AP_j is the per-hectare area payment for crop *j*,

C_j is the per-hectare deterministic variable cost for crop *j*,

FC is the fixed costs.

The experimental sample yield data consisted of nine annual observations. In simulation, sample data can be used to estimate the parameters for a parametric distribution (such as the normal). With sparse data, assumptions of parametric probability distributions can be problematic due to the lack of power of tests of those assumptions and the inability of the small sample to reflect the true parameters. An alternative is to let the «data speak» by using the empirical distribution. However, empirical distributions do not allow one to simulate beyond the range of observed data, which could bias the results if indeed values could extend beyond the observed minimum or maximum. This problem is especially relevant when the data are sparse, as in this case.

A better option when using sparse data is to apply a smoothing method to the empirical distribution estimation. Irregularities in an empirical distribution are often a result of sampling error or an unaccounted for structural influence. It is usually reasonable, therefore, to assume that the population follows a smooth distribution, implying that the irregularities should be adjusted in fitting a distribution (Anderson, 1974). Moreover, supplementary information that can make modelling the sparse data more reliable should be considered when smoothing. For example, the upper and lower bounds of a true underlying continuous distribution would often be more extreme than those observed from a sparse data set. Judgements from experts can be used to estimate such bounds. Figure 1 illustrates the empirical and a smoothed cumulative density function (CDF[2]) of organic barley yields in the Apelsvoll experiment. The experimental barley yield distribution was smoothed using a Gaussian kernel density function[3] with the addition of minimum and maximum values specified by a panel of experts. Silverman (1986) suggested the use of a kernel density function estimator (KDE) to smooth sparse data for a probability distribution. In this paper, the empirical distributions for prices and yields were smoothed using a KDE approach. The stochastic yields and prices for the crops were simulated using a more general version of the multivariate empirical (MVE) distribution estimation[4] described by Richardson *et al.* (2000) which allows

[2] A cumulative density function gives the probability that a stochastic variable is less than or equal to a specific value (Hardaker et al., 2004a). In the remainder of this paper, CDF will be used to indicate the sample CDF estimated from data.

[3] The kernel density approach is a formalisation of the free-hand approach to sketching in a curve to fit an empirical cumulative distribution: the basic idea is that one slides a weighting window along the yield/price scale, and the estimate of the density depends on the kernel of the assumed probability distribution. The smoothed estimate is a result of the individual observations that are weighted relative to the position of the window. See Silverman (1986: 13 19) for a technical description of the approach.

[4] A multivariate distribution consists of two or more stochastic dependent variables.

one to simulate the distributions as multivariate KDEs. The multivariate KDE procedure takes into account the stochastic dependency between the random variables when sampling in the simulation model (Richardson, 2004).

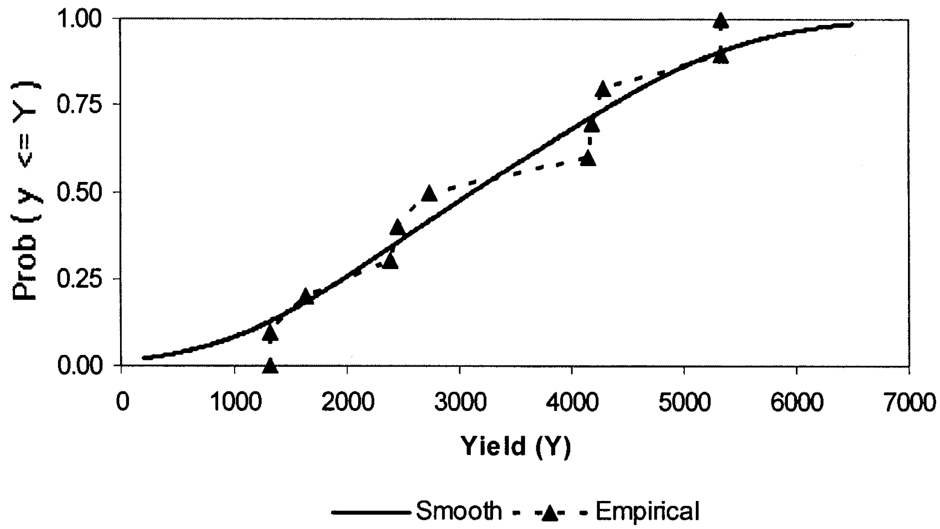

Figure 1 Empirical and smoothed cumulative density functions (CDFs) for organic barley yield per ha

Risk analysis requires both probabilities and preferences for outcomes held by the farmer. The subjective expected utility hypothesis (SEU) states that a rational person will seek to make risky choices consistently with what they believe, as measured by their subjective probabilities, and with what they prefer, as evaluated via their utility functions for consequences. The shape of the utility function reflects a person's attitude towards risk. Several attempts have been made to elicit such utility functions from farmers to put the SEU hypothesis to work in the analysis of risky alternatives for agriculture. Usually the results have been rather unconvincing. Partly to avoid the need to elicit a specific single-valued utility function, methods under the heading of stochastic efficiency criteria have been developed (Hardaker *et al.*, 2004a).

In this study we apply a method, called stochastic efficiency with respect to a function (SERF) (Hardaker *et al.*, 2004b) to compare the simulated empirical probability distributions of annual net farm income for the three cropping systems. The SERF method ranks risky alternatives, such as net incomes for alternative crop mixes, over a range of risk aversion levels. The ranking is made using sample certainty equivalents (CEs[5]) at each possible risk aversion level. As a result, the method allows one to show which risky alternative is preferred by decision makers who, e.g., are slightly risk-averse, moderately risk-averse, or highly risk-averse. Some technical details about the application of the SERF method and the assessed range of risk aversion used in this study are given in the Appendix.

[5] Certainty equivalent is defined as the sure sum with the same utility as the expected utility of a risky alternative (Hardaker et al., 2004a).

The simulation model used was programmed in Excel and simulated using the Excel Add-In Simetar© (Richardson, 2004). The SERF analysis of the simulated incomes for the alternative cropping systems was conducted using Simetar.

Results and discussion

Existing Norwegian price and public payment system

Results of simulating the three crop systems under the existing payment system and organic price premiums in Norway are presented as CDFs of annual net farm income in Figure 2.

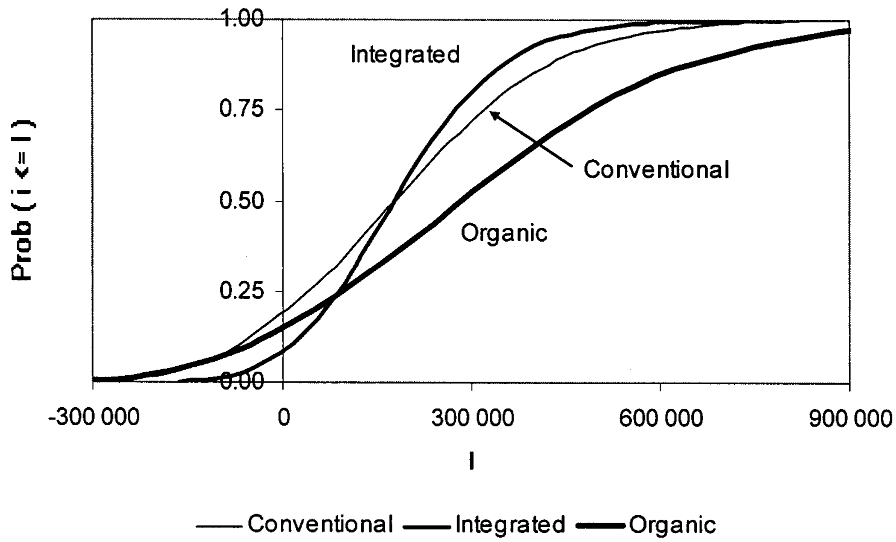

Figure 2 Simulated CDFs of annual net farm income (I) in NOK under conventional (CON), integrated (INT) and organic (ORG) cropping systems. (Farm size 40 ha.)

Three observations can be drawn from Figure 2. First, the ORG system in general shows a higher net farm income than the CON and INT systems. Second, the net income from the ORG system can be described as the one with the most uncertain income, as the CDF for ORG is less steep than the CDFs for CON and INT. Moreover, the ORG CDF has a lower minimum and a larger maximum than either of the other CDFs. The relative uncertainty for yields is generally highest for the ORG system (Table 2). In addition, the high yield uncertainty combined with the organic price premium has a multiplicative effect on the uncertainty of net farm income for the ORG farming system[6]. Third, under the existing payment schemes, all of the crop systems show some probability of generating negative net farm

[6] One referee correctly questioned the strong assumption that the organic potato price is in fixed ratio to the conventional price. A more flexible specification of the organic potato price was tested (uniformly distributed between 30 and 70% above conventional prices and the organic potato price independent of the other stochastic variables). The test results were very similar to the results obtained under the fixed ratio assumption.

income. For example, the CON system is associated with an 18% chance of experiencing a negative annual net farm income, while the corresponding chance is about 14% for the ORG system.

The expected annual net farm income for the simulated ORG system is NOK 302 000, for INT NOK 186 000, and for CON NOK 186 000. In other words, the CON and INT systems were found to have the same expected income. Crop yields were higher under the high input CON strategy, but were offset by cost savings for the INT system because of lower costs for tillage, fertiliser, and pesticides. Comparison of CDFs for the CON and INT crop systems shows that they have a slightly different risk profile, where the INT system has the lowest uncertainty. The alternative cropping system a farmer would prefer depends on his/her degree of risk aversion.

A SERF analysis of the three risky alternative cropping systems is summarized in Figure 3. At all risk aversion levels from risk-neutral to highly risk-averse, farmers would prefer the ORG farming system over the INT and CON systems. A risk-neutral farmer would rank the CON and INT cropping systems equally. The INT cropping system would be slightly more preferred than the CON system for farmers with some degree of risk aversion, because INT has higher CEs than the CON for all degrees of risk aversion.

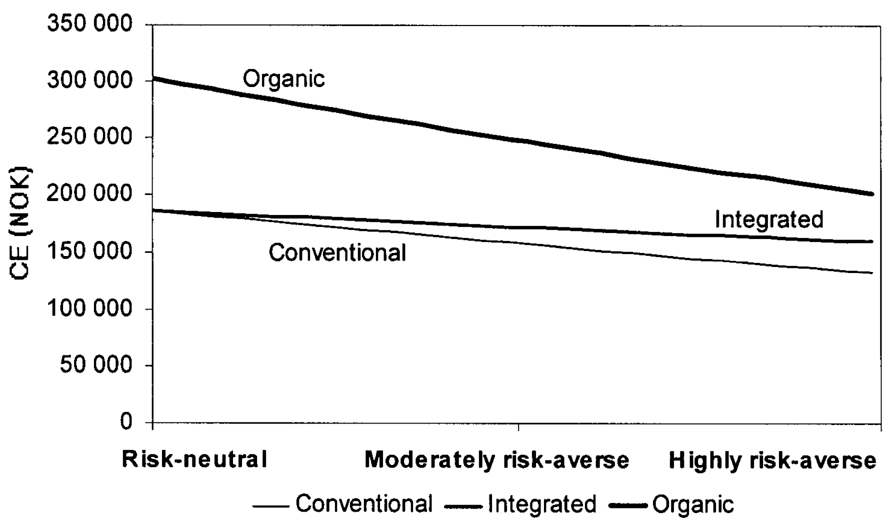

Figure 3 Certainty equivalent (CE) curves for annual net farm income in NOK for the conventional (CON), integrated (INT) and organic (ORG) simulated crop systems.

These findings can be compared with results of similar studies elsewhere. With organic price premiums included, North American field tests have also indicated higher economic returns for organic than for conventional cropping systems (e.g., Mahoney *et al.*, 2004; Smith *et al.*, 2004; Pimentel *et al.*, 2005). Smith *et al.* (2004) found slightly higher risk in the organic rotations, Mahoney *et al.* (2004) did not find returns in the organic strategies to be more variable than the conventional ones, while Pimentel *et al.* (2005) reported more variable returns in the conventional rotation.

Effects of removing organic area payments

The preceding results may be sensitive to changes in the payment system. If the area payments for organic farming are removed, ORG producers receive the same area payments as CON and INT producers. This policy change would alter the net farm income distribution for ORG (Figure 4).

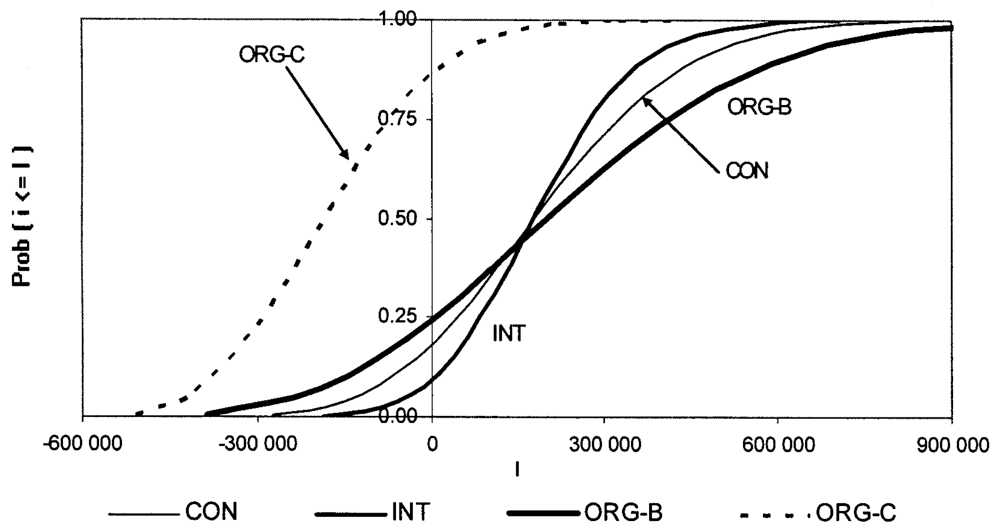

Figure 4 CDFs of annual net farm income (I) in NOK if organic area payments are removed for the simulated ORG system (ORG-B) and if organic area payments and price premiums are removed for that system (ORG-C).

Comparing Figure 4 with Figure 2, the expected negative shift in the CDF of annual net farm income for the ORG system if organic area payments are removed (ORG-B) can be seen. The expected annual net farm income for ORG drops from NOK 302 000 with organic area payments to NOK 220 000. Figure 5 shows the SERF ranking of the three cropping systems for different degrees of risk aversion under the no ORG area payments scenario (ORG-B). Under these circumstances, the ORG-B system is the most preferred for farmers with low to about moderate risk aversion and the INT system is preferred for farmers with moderate to high risk aversion.

It is possible to determine how large the organic area payment must be, under prevailing market prices, to make the ORG system as preferred as the CON or INT system for farmers with a given range or attitude toward risk. As an example, a highly risk-averse CON farmer who is offered an annual additional payment of NOK 19 000 (for example as organic area payment) would consider the economic viability of ORG production equal to that of the CON system.

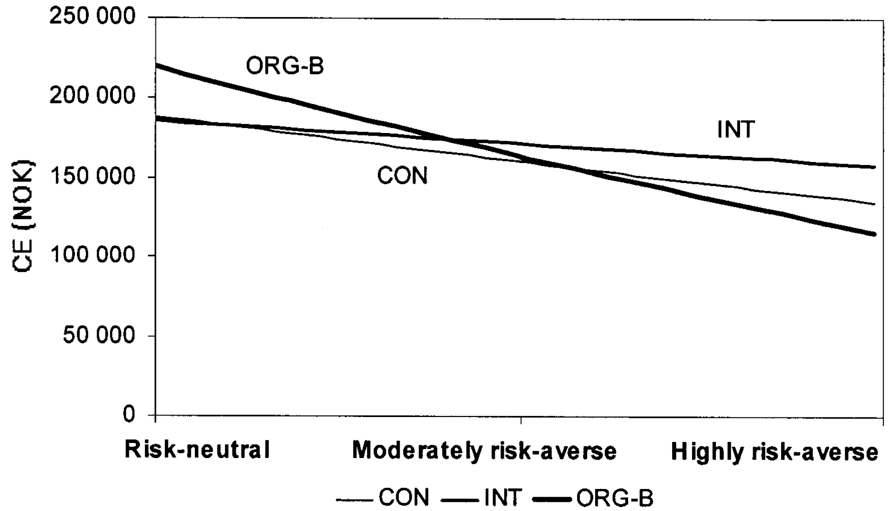

Figure 5 Scenario with no area payments for organic farming. CEs for annual net farm income in NOK for the CON, INT and ORG-B (without organic area payments) cropping systems.

Effects of removing organic area payments and organic price premiums

Comparing the dotted CDF in Figure 4 with the bold CDF in Figure 2 illustrates a dramatic negative shift in the CDF of annual net farm income of the ORG system if the organic area payments are removed and also the organic price premiums erode (ORG-C). At any level of risk aversion, the CON and INT production systems are preferred to the ORG-C farming system. The expected annual net farm income for ORG drops to a loss of NOK 176 000 for the scenario without organic support payments and price premiums. Figure 4 shows an 87% chance that the ORG-C system will generate a negative annual net farm income.

In comparison with these results, North American studies without organic price premiums have reported equal (Mahoney *et al.*, 2004) or lower (Smith *et al.*, 2004; Pimentel *et al.*, 2005) economic returns in organic than in conventional crop rotations. However, these studies did not show a dependency on price premiums and/or organic farming payments for organic cropping to be a viable option, to conventional crops.

Conclusions

The results show that the organic cropping system currently stands out as the most economically viable alternative and the most preferred alternative for risk-averse producers, even though annual net farm income is more uncertain. Without area payments for organic farming and organic price premiums, the other two cropping systems would be preferred by all farmers, regardless of degree of risk aversion.

Although the results are site specific for eastern Norway, the differences in performance between cropping systems may not be very different on other sites with similar environmental conditions.

Given the above findings of the current attractiveness of organic cropping, it is somewhat surprising that only 1.7% of the area of grain and potatoes crops in

Norway was under organic management in 2004. Several factors can explain the current low proportion of organic crop production. First, the relative variability in yields between years is highest for the organic system. Second, many farmers fear that the existing organic payment and organic price premiums will decrease (Koesling *et al.*, 2004), so they are fearful that conversion to organic production will not be worthwhile. Third, since farmers (as others) have a tendency to assign lower variance to the system they know than to unknown systems, the conventional farmers may subjectively assess the risks of converting as higher than our experimental data imply. Fourth, operations without livestock may have to rely on a complete legume-based organic cropping system instead of using manure as a nitrogen source. Additional labour is required in organic systems. Finally, some farmers are «committed conventional», completely rejecting the organic farming philosophy.

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Appendix

In SERF, to compute the CEs, we start by picking a particular form for the utility function for transitory income (in this study the negative exponential utility function). Transitory income is the good or bad income in any one year which is assumed to have little or no effect on the probability distribution of income in subsequent years (Friedman, 1957). Utility can then be calculated using the chosen utility function depending on the farmer's degree of risk aversion and the distribution of the transitory income. The distribution of the transitory income is the output from the simulation procedure. The calculated utility value is then converted to the certainty equivalent income for ease of interpretation.

The range of risk aversion to be used in the SERF analysis is crucial. The farmer's relative risk aversion with respect to wealth is the appropriate one for prescriptive analysis. It is important to get consistency between relative risk aversion with respect to wealth, $r_r(W)$ and absolute risk aversion with respect to transitory income, $r_a(I)$. By defining W as deterministic wealth and I as uncertain transitory income we have the following relationships: $r_a(I) = r_r(W)/W$. A realistic relative risk aversion coefficient with respect to wealth, $r_r(W)$ is within the bounds 0.5 to 4. In other words, we need to divide $r_r(W)$ by W for $r_r(W)$ in the range from 0.5 to 4 to obtain the approximately corresponding range expressed in $r_a(I)$. The typical level of a farmer's wealth, W, is assumed to be NOK 1 350 000. Then, a value of $r_a(I)$ in the range 0 (risk-neutral) to 0.000003 (highly risk-averse) corresponds to a $r_r(W)$ in the range 0 to 4. This range was used as the risk aversion bounds in this analysis. A more thorough treatment of SERF, how to consistently assess risk aversion coefficients across payoff measures, and other relevant references can be found in Hardaker et al. (2004a).

Vedlegg 13 Vitenskapelige utgivelser og annen publisering

Artikler i vitenskapelige tidsskrift med fagfellevurdering og bokkapittel

Flaten, O., Lien, G., Koesling, M., Valle. P.S., Ebbesvik, M., 2005. Comparing risk perceptions and risk management in organic and conventional dairy farming: empirical results from Norway. *Livestock Production Science* 95, 11–25.

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Innsendte artikler

Koesling, M., Ebbesvik, M., Lien, G., Flaten, O., Valle, P.S. Motives and potential for conversion to organic farming in Norway.

Lien, G., Schumann, K.D., Hardaker J.B., Richardson, J.W., Flaten, O. Simulating multivariate distributions with sparse data: a kernel density smoothing procedure.

Valle P.S., Flaten, O., Lien, G., Ebbesvik, M., Koesling, M. Herd health and health management in organic versus conventional dairy herds in Norway.

Det skal sendes inn ytterligere en artikkel – om 100 % kravet til økologisk fôr.

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Vedlegg 14 Spørreskjema om risiko i jordbruket

NILF
Norsk institutt for landbruksøkonomisk forskning

Oslo, 10. januar 2003

Kjære gardbruker

Spørreundersøkelse om risiko i jordbruket[1]

I jordbruket blir sjelden produksjon og økonomisk resultat som en tenker seg på forhånd. Risiko sier noe om de usikre konsekvensene, særlig de ugunstige. Risiko kan bl.a. bunne i uforutsigbart vær, usikkerhet om produksjonsnivå, prisvariasjoner og politiske forhold.

NILF, NORSØK og NVH ønsker din hjelp til å få svar på:

- **hva som er viktige risikokilder for økologiske og for konvensjonelle gardbrukere, og**
- **hvordan risikoen handteres.**

Resultatene av denne undersøkelsen vil gi politikere og byråkrater informasjon om hvordan politisk risiko (lover, reguleringer, støtteordninger, m.m.) og annen risiko oppfattes og håndteres hos gardbrukere. Gardbrukere og rådgivere vil få bedre innsikt i å ta hensyn til risiko.

For å redusere omfang av spørreundersøkelsen vil vi hente ut informasjon om areal og dyretall fra produksjonstilskuddsregistret til Statens landbruksforvaltning. Alle svar vil bli anonymisert og behandles konfidensielt. Rutiner for håndtering og bruk av data i undersøkelsen er godkjent av Datatilsynet.

Det tar om lag 30 minutter å fylle ut skjemaet, og vi ber deg returnere utfylt skjema i vedlagte svarkonvolutt innen mandag **3. februar 2003**. Alle som svarer får tilsendt et sammendrag av resultatene.

Har du spørsmål eller kommentarer til undersøkelsen, kan disse noteres på side 10 eller rettes til Ola Flaten, tlf. 22 36 72 55.

På forhånd takk for hjelpen!

Med vennlig hilsen

Ola Flaten

[1] Spørreundersøkelsen er en del av et større forskningsprosjekt om "Risiko og risikohåndtering i jordbruks-produksjonen" i samarbeid mellom Norsk institutt for landbruksøkonomisk forskning (NILF), Norsk senter for økologisk landbruk (NORSØK) og Norges veterinærhøgskole (NVH). Prosjektet varer frem til juni 2005.

Om driftsenheten og planer med gardsdrift

1 Hva er driftsenhetens eierforhold? *Sett ett kryss.*

A	☐	Enbruk/Enfamiliebruk	C	☐	Samdrift
B	☐	Tofamiliebruk	D	☐	Annet (*fyll inn*) ………………………..

2 Hvilke type produksjonsform er det på driftsenheten?
Sett ett kryss og fyll ut år i E og F hvis du krysser av for B, C eller D.

A ☐ Tradisjonell (konvensjonell) drift
B ☐ Kombinasjon av tradisjonell og økologisk drift
C ☐ Tradisjonell drift under omlegging til økologisk drift
D ☐ Økologisk drift

Hvis økologisk, årstall for godkjenning:

E år:______ Planteproduksjonen
F år:______ Husdyrholdet

3 Sett opp i prioritert rekkefølge de viktigste mål du har med gardsdrifta?
Angi inntil 5 mål, prioritert med tall fra 1 til 5, hvor 1 er det viktigste.

A ☐ Størst mulig inntekt
B ☐ Sikker og stabil inntekt
C ☐ Ha et selvstendig arbeid
D ☐ Drive miljøvennlig og bærekraftig, ta vare på kulturlandskapet
E ☐ Produsere mat av god kvalitet
F ☐ Mindre gjeld, bli gjeldfri
G ☐ Forbedre garden til neste generasjon
H ☐ Trivsel, god oppvekstplass for barn, og tid til familien
I ☐ Mulighet for å komme seg vekk fra bruket en gang i blant (ferie, fridager)
J ☐ Fortsette å være gardbruker
K ☐ Arbeide med dyr og/eller planter
L ☐ Øke privatforbruket
M ☐ Øke formuen (egenkapitalen)
N ☐ Dekke sosiale behov, samvær med andre mennesker
O ☐ Annet (*fyll inn*) ……………….………………………………………………

4 Hvilke planer har du for driftsenheten de kommende 5 år? *Flere kryss er mulig.*

A ☐ Ingen endring, fortsette som i dag
B ☐ Øke produksjonen på garden/driftsenheten
C ☐ Redusere produksjonen på garden/driftsenheten
D ☐ Intensivere driftsmåten
E ☐ Ekstensivere driftsmåten
F ☐ Utvide med en/flere produksjoner og/eller tilleggsnæringer
G ☐ Kjøpe/leie tilleggsjord
H ☐ Overdra/selge garden/driftsenheten til en etterfølger
I ☐ Avvikle
J ☐ Andre (*fyll inn*) ………………………………………………………….

Risikoholdning og risikokilder

5 Vurder følgende påstand: "Jeg/vi er villig til å ta mer risiko enn andre vedrørende": *Sett ett kryss for hver linje A-C.*

		Helt uenig 1	2	3	4	5	6	Helt enig 7
A	Produksjonen på garden	☐	☐	☐	☐	☐	☐	☐
B	Salg av produktene	☐	☐	☐	☐	☐	☐	☐
C	Investeringer og finansiering av disse	☐	☐	☐	☐	☐	☐	☐

6 Hvis du sammenligner din vilje til å ta risiko i 2003 med de siste 3 år, er den da *Sett kryss i intervallet 1-7 som passer best.*

Mye mindre 1	2	3	4	5	6	Mye større 7
☐	☐	☐	☐	☐	☐	☐

7 I hvilken grad antar du at driftsenhetens fremtidige økonomiske resultat påvirkes av følgende forhold (generelle risikokilder): *Sett ett kryss for hver linje i A-U.*

		Ingen avhengighet 1	2	3	4	5	6	Svært stor avhengighet 7
A	Variasjon i forbrukernes etterspørsel	☐	☐	☐	☐	☐	☐	☐
B	Usikkerhet om salg av produktene (produksjonskontrakter, direkte salg, videreforedlingsleddet m.m.)	☐	☐	☐	☐	☐	☐	☐
C	Jordleie (usikkerhet om pris, tilgang på areal m.m.)	☐	☐	☐	☐	☐	☐	☐
D	Varierende pris på driftsmidler (kraftfôr, gjødsel, diesel m.m.)	☐	☐	☐	☐	☐	☐	☐
E	Prisusikkerhet på anleggsmidler (maskiner, bygninger m.m.)	☐	☐	☐	☐	☐	☐	☐
F	Teknologiske endringer (uhensiktsmessig driftsapparat)	☐	☐	☐	☐	☐	☐	☐
G	Usikkerhet vedrørende lånerente	☐	☐	☐	☐	☐	☐	☐
H	Begrensede lånemuligheter	☐	☐	☐	☐	☐	☐	☐
I	Usikkerhet om merpris for økologiske produkt	☐	☐	☐	☐	☐	☐	☐
J	Usikkerhet om regelverk for økologisk jordbruksproduksjon	☐	☐	☐	☐	☐	☐	☐
K	Usikkerhet om andre reguleringer (miljøkrav, arb.miljø m.m.)	☐	☐	☐	☐	☐	☐	☐
L	Usikkerhet om tilskuddsordninger i økologisk jordbruk	☐	☐	☐	☐	☐	☐	☐
M	Usikkerhet om andre tilskuddsordninger i jordbruket	☐	☐	☐	☐	☐	☐	☐
N	Skatte- og avgiftspolitikk i jordbruket	☐	☐	☐	☐	☐	☐	☐
O	Helserisiko knyttet til bruker/samdriftspartnere (dødsfall, sjukdom, helt eller delvis arbeidsuførhet)	☐	☐	☐	☐	☐	☐	☐
P	Helserisiko til øvrige i brukerfamilien(e)	☐	☐	☐	☐	☐	☐	☐
Q	Usikkerhet om familieforhold (skilsmisse, fordeling av arbeidsoppgaver) og oppløsning av samdrift	☐	☐	☐	☐	☐	☐	☐
R	Leid arbeidskraft (usikkerhet om anskaffelse, stabilitet, pålitelighet)	☐	☐	☐	☐	☐	☐	☐
S	Brannskade (bygninger, dyr, maskiner, avlinger m.m.)	☐	☐	☐	☐	☐	☐	☐
T	Teknisk svikt på maskiner og utstyr	☐	☐	☐	☐	☐	☐	☐
U	Andre (*fyll inn*) ………………………………………………..…	☐	☐	☐	☐	☐	☐	☐

8 I hvilken grad antar du at driftsenhetens fremtidige økonomiske resultat påvirkes av følgende forhold (driftsspesifikke risikokilder):

Sett ett kryss for relevant(e) driftsform(er) i linjene V-AH.

		Ingen avhengighet 1	2	3	4	5	6	Svært stor avhengighet 7
I husdyrproduksjonen								
V	Variasjon i fôravlinger (forårsaket av vær, sjukdom/skadedyr, ugras m.m.)	☐	☐	☐	☐	☐	☐	☐
W	Forekomst av produksjonssjukdommer (mastitt, ketose m.m.)	☐	☐	☐	☐	☐	☐	☐
X	Utbrudd av smittsomme dyresjukdommer som vi har i Norge (om enn i begrenset omfang) (BVD, paratuberkulose, smittsom kuhoste m.m.)	☐	☐	☐	☐	☐	☐	☐
Y	Utbrudd av ”eksotiske” smittsomme dyresjukdommer, dvs sjukdommer som vi ikke har i Norge (munn og klauvsjuke, kugalskap m.m.)	☐	☐	☐	☐	☐	☐	☐
Z	Usikkerhet om fremtidig regelverk vedr. dyrevelferd (krav til mosjon, oppbinding, løsdrift m.m.)	☐	☐	☐	☐	☐	☐	☐
AA	Usikkerhet om fremtidig regelverk vedr. produksjonshygiene (krav til mjølkerom m.m.)	☐	☐	☐	☐	☐	☐	☐
I mjølkeproduksjonen								
AB	Variasjon i mjølkeavdrått	☐	☐	☐	☐	☐	☐	☐
AC	Variasjon i mjølkepris	☐	☐	☐	☐	☐	☐	☐
AD	Usikkerhet om regelverk for mjølkeproduksjon (inkl. evt. bortfall av mjølkekvoteordningen/toprisordningen)	☐	☐	☐	☐	☐	☐	☐
I kjøttproduksjonen								
AE	Variasjon i kjøttproduksjon (forårsaket av tilvekst, kreperte dyr, tap på beite, fruktbarhet m.m.)	☐	☐	☐	☐	☐	☐	☐
AF	Variasjon i kjøttpris	☐	☐	☐	☐	☐	☐	☐
I planteproduksjonen for salg								
AG	Variasjon i avlinger	☐	☐	☐	☐	☐	☐	☐
AH	Prisvariasjon	☐	☐	☐	☐	☐	☐	☐

9 Angi i prioritert rekkefølge fra spørsmål 7 og 8 de risikokilder du anser har størst betydning for drifta (de 3 risikofaktorer du frykter mest)?

Sett inn bokstaver fra tabellene i spørsmål 7 og 8.

1. ☐ 2. ☐ 3. ☐

10 Angi innenfor intervallet 1-7 hvilken påstand som passer best for deg/dere:

Sett kryss i intervallet 1-7 som passer best.

”Ta stor risiko og øke muligheten for høyere inntekt”						”Ta lite risiko og sikre en jevn, men kanskje lavere inntekt”
1	**2**	**3**	**4**	**5**	**6**	**7**
☐	☐	☐	☐	☐	☐	☐

11 Hvordan bedømmer du følgende utsagn? *Sett ett kryss for hver linje i A-M.*

		Helt uenig 1	2	3	4	5	6	Helt enig 7
A	Økonomisk resultat varierer mer fra år til år i økologisk jordbruk enn i konvensjonelt jordbruk	☐	☐	☐	☐	☐	☐	☐
B	I forhold til konvensjonelle bruk får økologiske bruk for mye produksjonstilskudd	☐	☐	☐	☐	☐	☐	☐
C	Konvensjonelt jordbruk er mer bærekraftig enn økologisk	☐	☐	☐	☐	☐	☐	☐
D	Uten kjemiske ugrasmidler vil ugrasproblemene øke	☐	☐	☐	☐	☐	☐	☐
E	Bruk av kjemiske plantevernmidler reduserer matkvaliteten	☐	☐	☐	☐	☐	☐	☐
F	Kunstgjødsel er nødvendig for å ikke pine ut jorda	☐	☐	☐	☐	☐	☐	☐
G	Kunstgjødsel må til for å gi plantene næring til rett tid	☐	☐	☐	☐	☐	☐	☐
H	Mindre fare for forurensning i økologisk drift	☐	☐	☐	☐	☐	☐	☐
I	Økologisk jordbruk gir rom for større biologisk mangfold	☐	☐	☐	☐	☐	☐	☐
J	Konvensjonelt dyrehold tar bedre vare på husdyras helse	☐	☐	☐	☐	☐	☐	☐
K	Økologisk dyrehold gir økt fare for sulteföring/feilernæring	☐	☐	☐	☐	☐	☐	☐
L	Økologisk dyrehold tar bedre vare på husdyras naturlige behov/velferd	☐	☐	☐	☐	☐	☐	☐
M	Trang økonomi går på bekostning av dyras helse og velferd	☐	☐	☐	☐	☐	☐	☐

Strategier for å håndtere risiko

12 Risiko kan reduseres på flere måter. Angi viktigheten for hver av strategiene nedenfor. *Sett ett kryss for hver linje i A-Z.*
For hver av strategiene, angi om den vil benyttes de neste tre årene. *Sett ring rundt ja eller nei.*

	Risikostrategier:	Ikke viktig 1	2	3	4	5	6	Svært viktig 7	Vil benytte?
A	Bruk av økonomiske rådgivningstjenester	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
B	Bruk av veterinære rådgivningstjenester	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
C	Bruk av f.eks. forsøksring eller produsenttjenesten	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
D	Produksjonskontrakter (bruk av kontrakter med varemottaker som fastsetter pris, kvantum, kvalitet, tid m.m.)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
E	Lagring (holde reserver for senere perioder – fôrlager, maskindeler, spre salg over tid m.m.)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
F	God likviditet/betalingsevne for å kunne betale regninger ved forfall	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
G	God soliditet, dvs. lite gjeld og stor formue/egenkapital	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
H	Fleksibilitet vedr. varige driftsmidler, f.eks. sette opp driftsbygninger som relativt lett kan nyttes til annet	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
I	Velge produkter med flere bruksområder (f.eks. korn til krossing eller salg) eller som kan selges i ulike markeder	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
J	Holde faste kostnader lave, ved å leie jord og maskiner i stedet for å eie	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
K	Utstrakt samarbeid eller felles drift med andre gardsbruk	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
L	Arbeid utenfor bruket/driftsenheten	☐	☐	☐	☐	☐	☐	☐	Ja / Nei

	Risikostrategier:	**Ikke viktig 1**	**2**	**3**	**4**	**5**	**6**	**Svært viktig 7**	**Vil benytte?**
M	Investere utenfor bruket/driftsenheten	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
N	Innsamling og analyse av informasjon (produksjon, ny teknologi, avsetningsmuligheter, markedstrender, m.m.)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
O	Kombinasjon av flere driftsgrener/produksjonsmåter (for å spre risiko og stabilisere inntekt fra driftsenheten)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
P	Produsere til lavest mulig kostnad	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
Q	Velge teknologier som reduserer risikoen (vatningsanlegg, grøfting, profilering, brannvarsling m.m.)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
R	Forebygge og redusere utbrudd av skadedyr og sjukdommer i planteproduksjon	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
S	Forebygge og redusere utbrudd av sjukdommer i husdyrproduksjon	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
T	Kjøpe landbruksforsikring (bygninger, maskiner, buskap, varelager m.m.)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
U	Kjøpe person- og ulykkesforsikring	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
V	Organisere driftsenheten som aksjeselskap (for å spre risiko og begrense ansvaret)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
W	Fellestiltak for å redusere prissvingninger (f.eks. deltagelse i landbrukssamvirke)	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
X	Gjøre små og gradvise endringer istedenfor store	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
Y	Ha ekstra maskinkapasitet	☐	☐	☐	☐	☐	☐	☐	Ja / Nei
Z	Andre (*fyll inn*) ……………………………………..	☐	☐	☐	☐	☐	☐	☐	Ja / Nei

13 Sett opp i prioritert rekkefølge de 3 viktigste risikostrategier fra spørsmål 12 som du anser har størst økonomisk betydning? *Angi bokstav fra tabellen ovenfor.*

1. ☐ 2. ☐ 3. ☐

14 Hvis du ser ut til å få lave jordbruksinntekter ett år, hva vil du gjøre?
Angi inntil 3 strategier, prioritert med tall fra 1 til 3, hvor 1 er den viktigste.

A	☐	Ingenting
B	☐	Ta /øke arbeid utenfor garden
C	☐	Utsette investeringer
D	☐	Selge eiendeler
E	☐	Ta flere oppdrag utenfor driftsenheten (brøyting, leiekjøring med mer)
F	☐	Øke avvirkningen i skogen
G	☐	Kjøpe brukt utstyr istedenfor nytt
H	☐	Ta opp lån
I	☐	Redusere privatforbruket
J	☐	Annet (*fyll inn*) ……………………………………..……………

Spørsmål 15-17 skal kun besvares av mjølkeprodusenter

Vennligst fortsett på side 7, spørsmål 18 hvis du ikke har mjølkeproduksjon.

15 Om egen håndtering av sjukdom/helseproblemer. *Sett ett kryss per linje.*

		Tiltak benyttes aldri	Tiltak benyttes av og til	Tiltak benyttes ofte
Tiltak mot/ved mastitt:				
A	Foretar du hyppig utmjølking av ku som er veterinærbehandlet?	☐	☐	☐
B	Foretar du hyppig utmjølking av ku som *ikke* er veterinærbehandlet?	☐	☐	☐
C	Masserer du med varmesalver (peppermynte/jod-kamfer)?	☐	☐	☐
D	Bruker du alternativ medisin (homøopati, naturmedisin og/eller akupunktur)?	☐	☐	☐
E	Plasseres ku/kvige med høyt celletall hos kalver for amming?	☐	☐	☐
F	Settes syk kjertel bort *uten* behandling?	☐	☐	☐
G	Settes syk kjertel bort *etter* behandling?	☐	☐	☐
H	Mjølkes syk kjertel separat (astronaut)?	☐	☐	☐
I	Slaktes kua uten behandling?	☐	☐	☐
Tiltak mot/ved ketose:				
J	Gir du tilskudd (energibalanse el)?	☐	☐	☐
K	Fordeler du kraftfôrrasjonen over flere tildelinger (mer enn to)?	☐	☐	☐
L	Gir du annet tilleggsfôr (høy, rotvekster, m.m.)?	☐	☐	☐
M	Bruker du holdvurdering?	☐	☐	☐
N	Følger du fôringsveilederes råd om fôring ved avsining og oppfôring før og etter kalving?	☐	☐	☐
Tiltak mot/ved mjølkefeber:				
O	Gir du kalktilskudd (bolus, gele)?	☐	☐	☐
P	Bruker du holdvurdering?	☐	☐	☐
Q	Følger du fôringsveilederes råd om fôring ved avsining og oppfôring etter kalving?	☐	☐	☐

16 Om egen notering i helsekortet. *Sett et kryss per linje.*

		Tiltak benyttes ikke	Noteres aldri	Noteres av og til	Noteres ofte
A	Alternativ behandling/medisin brukes	☐	☐	☐	☐
B	Noterer du i helsekortet hvis du foretar hyppige utmjølkinger av kyr/kviger som viser tegn til mastitt og som ikke blir behandlet av veterinær?	☐	☐	☐	☐
C	Noterer du i helsekortet hvis du benytter alternativ medisin (homøopati, naturmedisin eller annet)?	☐	☐	☐	☐
D	Noterer du i helsekortet hvis en kjertel med tegn til mastitt/celletall settes bort uten veterinærbehandling?	☐	☐	☐	☐
E	Noterer du i helsekortet hvis du setter bort kjertelen til ei ku som har tråkka på spenen?	☐	☐	☐	☐
F	Noterer du i helsekortet hvis du gir fôrtilskudd til kyr med ketose eller mjølkefeber?	☐	☐	☐	☐
G	Har du fått tilstrekkelig veiledning når det gjelder å notere hendelser i helsekortet?	☐ Ja		☐ Nei	

17 Om tilkalling av veterinær. Dersom du hadde 10 tilfeller av sjukdomstilstandene nedenfor i løpet av ett år, hvor mange ville du tilkalt veterinær til i dag og hvor mange ville du tilkalt veterinær til tidlig på 1990-tallet?

	Sjukdomstilstand	Tidlig i dag 0 = ingen, 10 = alle *(angi tall fra 0 til 10)*	Tidlig på 1990-tallet 0 = ingen, 10 = alle *(angi tall fra 0 til 10)*
A	Synlig (akutt) mastitt og dyret er allment påkjent		
B	Allment friske dyr m/Schalm-utslag		
C	Høyt celletall på helseutskrift		
D	Tegn til mastitt på nykalva kviger		
E	Ketose		
F	Mjølkefeber		

Spørsmål om garden/driftsenheten (jord- og hagebruket)

For samdrifter gjelder spørsmålene for samdrifta som helhet (alle samdriftsdeltakerne). For familiebruk o.l. gjelder spørsmålene for brukerfamilien.

18 Kryss av for hvem som har hovedansvaret for gardsdrifta?

A ☐ Kvinne
B ☐ Mann
C ☐ To eller flere i fellesskap

19 Hva er høyeste utdanning utover grunnskole blant de aktive deltagerne i drifta?

A ☐ Ingen
B ☐ Videregående skole (inkludert landbruksskole)
C ☐ Høyskole
D ☐ Vitenskapelig høyskole/universitet

20 Har noen av de aktive deltagerne i drifta formell landbruksutdanning?

☐ Ja ☐ Nei

21 Ca. antall årsverk (á 1.860 timer) i driftsenheten i år 2001?

………..… årsverk

22 Hvilke salgs- og distribusjonskanaler benytter du?
(ca. i % av salgsomsetning i jord- og hagebruket)

____ % utenfor samvirke

____ % innenfor samvirke

____ % direkte til forbruker/gardsutsalg/torgsalg

23 Myndighetene har som målsetning at 10% av det totale jordbruksarealet innen utgangen av 2009 skal være omlagt til økologisk drift. Hvordan vurderer du driftsenhetens situasjon i forhold til dette? *Sett ett kryss.*

A ☐ Vil fortsette med økologisk drift, *fortsett med spørsmål 24*
B ☐ Vil legge om til økologisk drift på hele driftsenheten, *fortsett med spørsmål 24*
C ☐ Vil legge om til økologisk drift på deler av driftsenheten, *fortsett med spørsmål 24*
D ☐ Ingen planer om å legge om til økologisk drift, *fortsett med spørsmål 25*
E ☐ Vil gå over fra økologisk til konvensjonell drift, *fortsett med spørsmål 25*
F ☐ Vet ikke, *fortsett med spørsmål 26*

24 Hva var/er motivene for å legge om til økologisk drift?
Angi inntil 3 motiver, prioritert med tall fra 1 til 3, hvor 1 er det viktigste.

A ☐ Mer dyrevennlig produksjon
B ☐ Bedre jordfruktbarhet, mindre forurensing
C ☐ Bedre lønnsomhet
D ☐ Mer stabil inntekt
E ☐ Ekstra tilskudd til økologisk drift
F ☐ Mindre helserisiko (for eksempel plantevernmidler)
G ☐ Ideologiske og/eller filosofiske hensyn
H ☐ Produsere mat av høy kvalitet
I ☐ Interessante faglige utfordringer
J ☐ Naturgitte forhold
K ☐ Andre (*fyll inn*) ……………………………………………………………………….

25 Hva var/er motivene for å drive konvensjonelt?
Angi inntil 3 motiver, prioritert med tall fra 1 til 3, hvor 1 er det viktigste.

A ☐ Mer dyrevennlig produksjon
B ☐ Bedre jordfruktbarhet, mindre forurensing
C ☐ Bedre lønnsomhet
D ☐ Mer stabil inntekt
E ☐ Utnytte mulighetene for effektiv drift (ved bruk av kunstgjødsel, plantevernmidler, innkjøpt fôr m.m.)
F ☐ Ideologiske og/eller filosofiske hensyn
G ☐ Produsere mat av høy kvalitet
H ☐ Økologisk drift krever mer arbeid
I ☐ Interessante faglige utfordringer
J ☐ Naturgitte forhold
K ☐ Andre (*fyll inn*) ………………………………………………………………………..

26 (Gjelder bare husdyrprodusenter) Hvor stor andel av de enkelte fôrslag og den totale fôrrasjonen kjøpes inn?
Gjennomsnitt for alle dyreslag på energibasis; ca. i %

A av grovfôr (surfôr, høy, beite, gras) innkjøpt _____%

B av kraftfôr innkjøpt _____%

C av annet fôr innkjøpt _____%

D av total fôrrasjon innkjøpt _____%

27 (Gjelder bare økologisk husdyrhold) Fra 2005 skal alt fôr være av økologisk opprinnelse. Hva vil en slik regel bety for driftsopplegget på garden din?
Sett et eller flere kryss.

A	☐	Skaffe mer areal for å dyrke mer økologisk fôr selv
B	☐	Erstatte innkjøpt konvensjonelt med økologisk fôr
C	☐	Mjølkeproduksjonen reduseres med ca _____%
D	☐	Kjøttproduksjonen reduseres med ca _____%
E	☐	Husdyrhold blir lagt om for å bruke mindre kraftfôr (for eksempel lavere mjølke-ytelse, ammekyr istedenfor mjølkekyr)
F	☐	Husdyrholdet blir avviklet
G	☐	Vil gå over fra økologisk til konvensjonell drift
H	☐	Andre (*fyll inn*) …………………………………………………………………

Spørsmål om brukeren
(den som har mottatt spørreskjemaet) inkludert evt. ektefelle/samboer

28 Sivil status. Er du? *Sett ett kryss.*

A	☐	Enslig
B	☐	Gift
C	☐	Samboer

29 Hvor lang erfaring har du med gardsdrift? *Oppgi ca.*

Antall år ………….

30 Har du/dere arbeid *utenfor* driftsenheten i dag?
Sett kryss og fyll inn hvis ja.

			Stillingsandel utenom	Yrke(r)
A Kvinne	☐ Ja	☐ Nei	_____ %	
B Mann	☐ Ja	☐ Nei	_____ %	

31 Hvis du/dere arbeider utenfor driftsenheten, hva er grunner til det?
Sett ett kryss for hver linje i A-G.

		Ikke Viktig 1	**2**	**3**	**4**	**5**	**6**	**Svært viktig 7**
A	Øke familiens inntekt	☐	☐	☐	☐	☐	☐	☐
B	Ha en mer stabil inntekt	☐	☐	☐	☐	☐	☐	☐
C	Komme ut i annen sosial sammenheng	☐	☐	☐	☐	☐	☐	☐
D	Utnytte ledig arbeidskapasitet	☐	☐	☐	☐	☐	☐	☐
E	Ha mulighet til annet arbeid i fremtiden	☐	☐	☐	☐	☐	☐	☐
F	Ønske om å arbeide med noe annet	☐	☐	☐	☐	☐	☐	☐
G	Annet (*fyll inn*)………………………..	☐	☐	☐	☐	☐	☐	☐

32 Har du de siste 5 år investert noe utenfor garden/driftsenheten (f.eks. aksjer, aksjefond, eiendomsinvesteringer, annen næringsvirksomhet etc.)? *Sett ett kryss.*

A ☐ Nei
B ☐ Ja, for mindre enn kr. 50.000
C ☐ Ja, mellom kr. 50.000 og 500.000
D ☐ Ja, for mer enn kr. 500.000

33 Hvor stor var din/deres næringsinntekt fra jord- og hagebruk m.m. for 2001? (Post 2.7.1 i selvangivelse for næringsdrivende, bruker og ev. ektefelle.) *Sett ett kryss.*

A	☐	Mindre enn 50.000 kr	D	☐	200.000 - 300.000 kr
B	☐	50.000 – 100.000 kr	E	☐	300.000 – 400.000 kr
C	☐	100.000 - 200.000 kr	F	☐	Mer enn 400.000 kr

34 Hvor stor var din/deres totale inntekt (inkl. kapitalinntekter) i 2001? (Post 3.1.10 i selvangivelse for næringsdrivende, bruker og ev. ektefelle.) *Sett ett kryss.*

A	☐	Mindre enn 200.000 kr	D	☐	500.000 – 650.000 kr
B	☐	200.000 - 350.000 kr	E	☐	650.000 - 800.000 kr
C	☐	350.000 - 500.000 kr	F	☐	Mer enn 800.000 kr

35 Oppgi din/deres gjeld og nettoformue per 31.12.2001. (Post 4.8.4 og 4.9 i selvangivelsen.) *Sett ett kryss for gjeld (A-E) og ett kryss for nettoformue (F-J).*

		Gjeld			**Nettoformue**
A	☐	Mindre enn 200.000 kr	F	☐	Mindre enn 200.000 kr
B	☐	200.000 – 500.000 kr	G	☐	200.000 – 500.000 kr
C	☐	500.000 – 1.000.000 kr	H	☐	500.000 – 1.000.000 kr
D	☐	1.000.000 – 1.500.000 kr	I	☐	1.000.000 – 1.500.000 kr
E	☐	Over 1.500.000 kr	J	☐	Over 1.500.000 kr

36 Evt. kommentarer til spørreundersøkelsen (evt. benytt eget ark)

…………………………………………………………………………………………
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Tusen takk for at du tok deg tid til å svare!